NFPA®

1670

Standard on Operations and Training for Technical Search and Rescue Incidents

2017

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NFPA® 1670

Standard on

Operations and Training for Technical Search and Rescue Incidents

2017 Edition

This edition of NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*, was prepared by the Technical Committee on Technical Search and Rescue. It was issued by the Standards Council on November 11, 2016, with an effective date of December 1, 2016, and supersedes all previous editions.

This edition of NFPA 1670 was approved as an American National Standard on December 1, 2016.

Origin and Development of NFPA 1670

The responsibility for NFPA 1470, *Standard on Search and Rescue Training for Structural Collapse Incidents*, 1994 edition, was transferred to the Technical Committee on Technical Rescue, which prepared a proposed new standard, NFPA 1670, *Standard on Operations and Training for Technical Rescue Incidents*. That document incorporated the scope of NFPA 1470, expanding it to include identifying and establishing levels of functional capability for safety and effectively conducting operations at technical rescue incidents.

The 2004 edition of NFPA 1670 represented a complete revision and incorporated reorganization of the chapters to comply with the new *Manual of Style for NFPA Technical Committee Documents*. The title of the document was changed to *Standard on Operations and Training for Technical Search and Rescue Incidents* as a result of a petition by the Technical Committee to the Standards Council to include "search" as part of the scope of the Committee. The search element was also added to each of the disciplines within the document.

The committee acknowledged the valuable contributions of George Howard to the origin and development of this document. Mr. Howard was working as a police officer for the New York and New Jersey Port Authority when he perished in the line of duty on September 11, 2001, at the World Trade Center at the age of 44. He was a 16-year veteran of the department and a founding member of its elite emergency services division and was awarded the New York Police Department's Medal of Valor for rescuing children trapped in the World Trade Center during the 1993 bombing. Mr. Howard was a charter member of the NFPA Technical Rescue Technical Committee, on which he represented the Nassau County (NY) Fire Academy. His enlightened influence and hard work will always be a part of this document.

In the third edition of NFPA 1670, the Vehicle and Machinery Search and Rescue component was split into two separate chapters, and new chapters on Cave Search and Rescue, Mine and Tunnel Search and Rescue, and Helicopter Search and Rescue were added, resulting in renumbering of chapters within the document. Annex G was updated with material on the Search Assessment Marking System, and Annex H was revised with guidelines for initial response planning. Annex I was deleted, and the remaining annexes were renumbered.

For the 2014 edition, the committee added new chapters on Tower Rescue and Animal Technical Rescue. Chapter 16, Tower Rescue, was incorporated into the standard to address the significant hazards posed to technical rescuers associated with the removal of ill or injured persons from manmade tower structures. The adoption of the PETS Act in October 2006 authorized FEMA to provide rescue, care, shelter, and essential needs for individuals with household pets and service animals—and for the household pets and animals themselves—following a major disaster or emergency. That prompted the committee to incorporate a new Chapter 17, Animal Technical Rescue, and a new Annex K, Animal Technical Rescue, to address the significant hazards posed to technical rescuers associated with the rescue of injured or entrapped animals. Other notable changes to the 2014 edition included the reorganization of Chapter 3, Definitions; changes to confined space rescue team size requirements in Chapter 7, Confined Space Search and Rescue; new requirements

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specific to floods in Chapter 9, Water Search and Rescue; and new requirements specific to elevators in Chapter 12, Machinery Search and Rescue.

The NFPA Technical Committee on Technical Search and Rescue recognized the contributions of our colleague, long-time staff liaison, and friend, Frank Florence (1943–2010). Frank passed away on July 27, 2010, after a relatively brief illness. He served with the Salt Lake City Fire Department for 31 years before retiring as Fire Chief. After retiring from SLCFD, Frank joined the NFPA in September of 1998 and served as the staff liaison for the Technical Search and Rescue Committee for twelve years. Frank was a strong advocate for the work of our committee and of the SAR community in general. His memory and contributions will continue to influence NFPA 1670, and the committee is forever grateful for his support and assistance.

For the 2017 edition, NFPA 1670 underwent a significant restructuring. Significant work was done to correlate the material found in both NFPA 1670 and NFPA 1006 through a joint task group. Correlation establishes a consensus for Awareness, Operations, and Technician for emergency responder levels between the documents, utilizing the same definitions in NFPA 1670 and NFPA 1006 and aligning chapters where possible. Chapters have been created for Floodwater and Watercraft to further reflect various water-type rescue challenges.

The NFPA Technical Committee on Technical Search and Rescue would like to recognize the contributions of our colleague and friend, Steve Hudson (1950-2013). Steve's insight and expertise were invaluable in the development of rope rescue system aspects throughout the standard, and his contributions will continue to be ever present. Steve's contributions and comradery will be missed.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on technical search and rescue techniques, operations, and procedures to develop efficient, proper, and safe utilization of personnel and equipment.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex K. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex K.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard shall identify and establish levels of functional capability for conducting operations at technical search and rescue incidents while minimizing threats to rescuers.

1.1.2* The requirements of this standard shall apply to organizations that provide response to technical search and rescue incidents, including those not regulated by governmental mandates.

1.1.3* It is not the intent of this document to be applied to individuals and their associated skills and/or qualifications.

1.2* Purpose.

1.2.1 The purpose of this standard shall be to assist the authority having jurisdiction (AHJ) in assessing a technical search and rescue hazard within the response area, to identify the level of operational capability, and to establish operational criteria.

1.2.2 The functional capabilities of this standard shall be permitted to be achieved in a variety of ways.

1.3 Equivalency. Nothing in this standard shall be intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety in place of those prescribed by this standard, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard, and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2013 edition.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2017 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2013 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, 2014 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI/CGA G7.1, *Commodity Specification for Air*, 2011.

2.3.2 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

FEMA National Response Framework, 2nd edition, 2013.

FEMA National Urban Search and Rescue (US&R) Response System, 2006.

U.S. Coast Guard National Search and Rescue Committee, *U.S. National Search and Rescue Plan*, 2007.

2.3.3 Other Publications. *Merriam-Webster's Collegiate Dictionary*, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

National Cave Rescue Commission of the National Speleological Society— Cave Orientation Course.

2.4 References for Extracts in Mandatory Sections.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2017 edition.

NFPA 1021, *Standard for Fire Officer Professional Qualifications*, 2014 edition.

NFPA 1521, *Standard for Fire Department Safety Officer Professional Qualifications*, 2015 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, 2014 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2017 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Shall. Indicates a mandatory requirement.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

3.2.5 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Acceptable Entry Conditions. Conditions that must exist in a space to allow entry and to ensure that employees can safely enter into and work within the space.

3.3.2 Alternate Air Source. A secondary air supply source system that involves an alternate second-stage regulator provided by either a separate dedicated second-stage or a multipurpose second-stage regulator coupled with a buoyancy compensator inflator valve.

3.3.3 Anchor Point. A single, structural component used either alone or in combination with other components to create an anchor system capable of sustaining the actual and potential load on the rope rescue system.

3.3.4 Anchor System. One or more anchor points rigged in such a way as to provide a structurally significant connection point for rope rescue system components.

3.3.5 Animal Technical Rescue. Rescuing of an animal requiring technical skills; not to be confused with "animal rescue" which typically refers to abuse or neglect.

3.3.6 Ascending Device. A type of rope grab; auxiliary equipment; a friction or mechanical device utilized to allow ascending a fixed line. [**1983,** 2017]

3.3.7 Ascending (Line). A means of safely traveling up a fixed line with the use of one or more ascent devices.

3.3.8 Assessment Phase (Size-Up). The process of assessing the conditions, the scene, and the subject's condition and ability to assist in his or her own rescue.

3.3.9 Auxiliary Equipment. Equipment items that are load-bearing and designed to be utilized with life safety rope and harness. [**1983,** 2017]

3.3.10* Avalanche. A mass of snow — sometimes containing ice, water, and debris — that slides down a mountainside.

3.3.11* Belay. The method by which a potential fall distance is controlled to minimize damage to equipment and/or injury to a live load.

3.3.12 Bell-Bottom Pier Hole. A type of shaft or footing excavation, the bottom of which is made larger than the cross-section above to form a bell shape.

3.3.13 Benching or Benching System. A method of protecting employees from cave-ins by excavating the side of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

3.3.14 Bend. A knot that joins two ropes or webbing pieces together.

3.3.15* Body Substance Isolation. An infection control strategy that considers all body substances potentially infectious. It utilizes procedures and equipment to protect the responder from communicable diseases that are known to be transmitted through blood and other body substances.

3.3.16 Buoyancy Compensator (BCD). Device worn by a diver containing a bladder that is inflated or deflated by the diver to manage their buoyancy while immersed in a liquid.

3.3.17* Cave. A natural underground void formed by geologic process. [**1006,** 2017]

3.3.18 Cave-In. The separation of a mass of soil or rock material from the side of an excavation or trench, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

3.3.19 Collapse Safety Zone. An area around a collapsed structure or structures that is outside the potential collapse zone of falling debris.

3.3.20 Compass. A device that uses the earth's magnetic field to indicate relative direction.

3.3.21 Competent Person. One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. [**1006,** 2017]

3.3.22* Confined Space. A space that is large enough and so configured that a person can enter and perform assigned work, that has limited or restricted means for entry or exit (e.g.,

tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and that is not designed for continuous human occupancy.

3.3.23 Confined Space Rescue Service. The confined space rescue team designated by the AHJ to rescue victims from within confined spaces, including operational and technical levels of industrial, municipal, and private sector organizations.

3.3.24 Confined Space Rescue Team. A combination of individuals trained, equipped, and available to respond to confined space emergencies.

3.3.25* Coverage (sometimes called "coverage factor"). A relative measure of how thoroughly an area has been searched or "covered."

3.3.26 Cribbing. Short lengths of timber/composite materials, usually 4 in. × 4 in. (101.60 mm × 101.60 mm) and 18 in. – 24 in. (457.20 mm – 609.60 mm) long, that are used in various configurations to stabilize loads in place or while load is moving.

3.3.27* Critical Angle. A deflection in two rope rescue system components that increases any force vector beyond that which is acceptable.

3.3.28 Descending (Line). A means of safely traveling down a fixed line using a descent control device.

3.3.29 Descent Control Device. An auxiliary equipment item; a friction or mechanical device utilized with rope to control descent. [**1983,** 2017]

3.3.30 Disentanglement. The cutting of a vehicle and/or machinery away from trapped or injured victims.

3.3.31 Dive. Exposure of an individual to a hyperbaric environment.

3.3.32 Dive Profile. Description and documentation of a diver's potential or actual exposure to a hyperbaric environment, which includes depth, duration of exposure, and, where applicable, intervals between exposures, which is intended to document and communicate the diver's nitrogen load.

3.3.33 Dive Supervisor. The member of a dive team who has the authority and expertise to manage and direct all aspects of the dive operation and has been trained to meet all nondiving job performance requirements of technician-level dive rescue as defined in NFPA 1006.

3.3.34 Dive Tables. Tools used to calculate a diver's nitrogen loading based on depth, length of exposure to a hyperbaric environment, and intervals between exposures of an actual or a planned dive.

3.3.35 Dive Team. A collection of divers and trained support personnel acting under the direction of a single team leader who are trained and equipped to act collectively to achieve a subsurface mission using a common set of practices or guidelines.

3.3.36 Dive Tender. A member of the dive team who is responsible for assisting divers with assembly and donning of equipment, communicating with divers, tracking the diver's status and location, and managing subsurface search operations, and trained to meet all the job performance requirements of operations-level dive rescue as defined in NFPA 1006.

3.3.37 Diver. An individual exposed to a hyperbaric environment while using a compressed gas or supplied breathing gas system.

3.3.37.1* ***90 Percent Diver.*** A diver who is dressed, equipped, and positioned to quickly enter the water and assume the role of safety diver or otherwise assist the operation as necessary.

3.3.37.2* ***Safety Diver.*** A diver who is equipped and positioned to immediately submerge and lend assistance to a diver in distress or to engage in a search for a missing diver.

3.3.38 Edge Protection. A means of protecting software components within a rope rescue system from the potentially harmful effects of exposed sharp or abrasive edges.

3.3.39 Emergency Incident. Any situation to which an emergency services organization responds to deliver emergency services, including rescue, fire suppression, emergency medical care, special operations, law enforcement, and other forms of hazard control and mitigation. [**1561,** 2014]

3.3.40 Emergency Medical Service (EMS). The organization(s) responsible for the care and transport of sick and injured persons to an appropriate emergency care facility. Referred to as Emergency Services in U.S. federal confined space regulations.

3.3.41 Engulfment. The surrounding and effective capture of a person by a fluid (e.g., liquid, finely divided particulate) substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

3.3.42 Entry. The action by which a person passes into a confined space. Entry includes ensuing work or rescue activities in that environment and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space, trench, or excavation.

3.3.43* Entry Permit. A written or printed document, established by an employer, for nonrescue entry into confined spaces.

3.3.44 Entry Team. The group of individuals, with established communications and leadership, assigned to perform work or rescue activities beyond the opening of, and within, the space, trench, or excavation.

3.3.45* Environment. A collection of characteristics such as weather, altitude, and terrain contained in an area that are unique to a location.

3.3.46 Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by the removal of earth.

3.3.47 Extrication. The removal of trapped victims from a vehicle or machinery.

3.3.48 Face(s). The vertical or inclined earth surface formed as a result of excavation work.

3.3.49 Failure. The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

3.3.50* FEMA Task Force Structure/Hazard Evaluation Marking System. Distinct markings made with international orange spray paint, after performing a building hazard identification, near a collapsed structure's most accessible point of entry.

3.3.51* FEMA Task Force Structure Marking System, Structure Identification Within a Geographic Area. Distinct markings made with international orange spray paint to label buildings with their street number so that personnel can differentiate one building from another.

3.3.52 Fixed Line (Fixed Line System). A rope rescue system consisting of a nonmoving rope attached to an anchor system.

3.3.53 Force Multiplier. Any load, object, environmental factor, or system configuration that increases the load on the anchor system(s).

3.3.54 Full-Face Mask. A diving mask that covers the diver's entire face, includes a regulator for breathing, has separate inhalation and exhalation chambers, provides for defogging, free flow if the seal is broken, and provides for a communication module.

3.3.55* General Area. An area surrounding the incident site (e.g., collapsed structure or trench) whose size is proportional to the size and nature of the incident. Within the general area, access by people, heavy machinery, and vehicles is limited and strictly controlled.

3.3.56 Hardware (Rope Rescue). Rigid mechanical auxiliary equipment that can include, but is not limited to, anchor plates, carabiners, and mechanical ascent and descent control devices.

3.3.57 Hasty Search. An initial deployment of search resources that involves a quick search of areas or segments likely to contain survivors.

3.3.58 Hazard Identification. The process of identifying situations or conditions that have the potential to cause injury to people, damage to property, or damage to the environment.

3.3.59 Hazardous Atmospheres. Any atmosphere that can expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of ability to self-rescue.

3.3.60 Heavy Object. An item of such size and weight that it cannot be moved without the use of power tools (e.g., hydraulic lifting devices) or complex mechanical advantage systems.

3.3.61 High Angle. Refers to an environment in which the load is predominantly supported by the rope rescue system.

3.3.62 Hitch. A knot that attaches to or wraps around an object so that when the object is removed, the knot will fall apart.

3.3.63 Immediately Dangerous to Life or Health (IDLH). Any condition that would pose an immediate or delayed threat to life, cause irreversible adverse health effects, or interfere with an individual's ability to escape unaided from a hazardous environment.

3.3.64 Imminent Hazard. An act or condition that is judged to present a danger to persons or property and is so immediate and severe that it requires immediate corrective or preventive action.

3.3.65 Incident Command System (ICS). The combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure that has responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident or training exercise.

3.3.66 Incident Management System (IMS). A system that defines the roles and responsibilities to be assumed by personnel and the operating procedures to be used in the management and direction of emergency operations; the system is also referred to as an incident command system (ICS). [**1021,** 2014]

3.3.67 Incident Response Plan. Written procedures, including standard operating guidelines, for managing an emergency response and operation.

3.3.68* Incident Scene. The location where activities related to a specific incident are conducted.

3.3.69* Isolation System. An arrangement of devices, including isolation devices, applied with specific techniques, that collectively serve to isolate a victim of a trench or excavation emergency from the surrounding product (e.g., soil, gravel, or sand).

3.3.70* Knot. A fastening made by tying rope or webbing in a prescribed way.

3.3.71* Large Animal. Domesticated livestock including, but not limited to, horses, cows, mules, donkeys, goats, llamas, alpacas, pigs, and excluding wild animals and household pets.

3.3.72 Large Machinery. Complex machines (or machinery systems) constructed of heavy materials, not capable of simple disassembly, and presenting multiple concurrent hazards (e.g., control of energy sources, HAZMAT, change in elevation, multiple rescue disciplines, etc.), complex victim entrapment, or partial or complete amputation, and requiring the direct technical assistance of special experts in the design, maintenance, or construction of the device or machine.

3.3.73 Laser Target. A square or rectangular plastic device used in conjunction with a laser instrument to set the line and grade of pipe.

3.3.74 Life Safety Harness. An equipment item; an arrangement of materials secured about the body to support a person. [**1983,** 2017]

3.3.75 Life Safety Rope. Rope dedicated solely for the purpose of supporting people during rescue, fire fighting, other emergency operations, or during training evolutions.

3.3.76 Litter. A transfer device designed to support and protect a victim during movement.

3.3.77 Litter Tender. A person who both accompanies and physically manages the litter.

3.3.78* Lockout. A method for keeping equipment from being set in motion and endangering workers. *(See also 3.3.147, Tagout.)*

3.3.79 Low Angle. Refers to an environment in which the load is predominantly supported by itself and not the rope rescue system (e.g., flat land or mild sloping surface).

3.3.80* Lowering System. A rope rescue system used to lower a load under control.

3.3.81 Machine. Human-made system or device made up of fixed and moving parts that perform a task.

3.3.82 Machinery. The moving parts of a particular machine.

3.3.83 Maximum Working Load. Weight supported by the life safety rope and system components that must not be exceeded.

3.3.84* Minimum Primary Reserve Pressure. Minimum permissible breathing gas pressure remaining in a SCUBA diver's primary delivery system on reaching the surface and establishing positive buoyancy.

3.3.85* Mechanical Advantage (M/A). A force created through mechanical means including, but not limited to, a system of levers, gearing, or ropes and pulleys usually creating an output force greater than the input force and expressed in terms of a ratio of output force to input force.

3.3.86 Member. A person performing the duties and responsibilities of an emergency response organization on a full-time or part-time basis, with or without compensation.

3.3.87* Multiple-Point Anchor System. System configuration providing load distribution over more than one anchor point, either proportionally or disproportionally. *(See also 3.3.4, Anchor System.)*

3.3.88* National Response Framework. An overview of key response principles, roles, and structures that guides the U.S. national response and that describes (a) how communities, states, the federal government, and private sector and nongovernmental partners apply these principles for a coordinated, effective national response; (b) special circumstances where the federal government exercises a larger role, including incidents where federal interests are involved and catastrophic incidents where a state would require significant support; and (c) how these elements come together and are implemented by first responders, decision makers, and supporting entities to provide a unified national response in the United States.

3.3.89* National Search and Rescue Plan. A document that identifies responsibilities of U.S. federal agencies and serves as the basis for the *U.S. National Search and Rescue Manual*, which discusses search and rescue organizations, resources, methods, and techniques utilized by the federal government.

3.3.90 One-Call Utility Location Service. A service from which contractors, emergency service personnel, and others can obtain information on the location of underground utilities in any area.

3.3.91 Oxygen-Deficient Atmosphere. Air atmospheres containing less than 19.5 percent oxygen by volume at one standard atmosphere pressure.

3.3.92 Oxygen-Enriched Atmosphere. Air atmospheres containing more than 23.5 percent oxygen by volume at one standard atmosphere pressure.

3.3.93 Packaging (Patient Packaging). The process of securing a subject in a transfer device, with regard to existing and potential injuries/illness, so as to avoid further harm during movement.

3.3.94 Panel Team. The group of individuals, with established communications and leadership, assigned to construct (if necessary), move, place, and manage panels (traditional sheeting panels) both inside and outside the space, trench, or excavation.

3.3.95* Personal Protective Equipment (PPE). The equipment provided to shield or isolate personnel from infectious, chemical, physical, and thermal hazards.

3.3.96 Personnel. Any individual participating within the incident scene.

3.3.97 Pre-Entry Briefing. Information passed to all personnel prior to entry into a confined space or trench/excavation environment.

3.3.98 Primary Access. The existing opening of doors and/or windows that provide a pathway to the trapped and/or injured victim(s).

3.3.99* Primary Search. A quick search of the structures likely to contain survivors.

3.3.100* Protective System. A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures.

3.3.101 Public Safety Diving. Underwater diving, related to team operations and training, performed by any member, group, or agency of a community or government-recognized public safety diving or water rescue team.

3.3.102 Pulley. A device with a free-turning, grooved metal wheel (sheave) used to reduce rope friction. Side plates are available for a carabiner to be attached.

3.3.103* Raising System. A rope rescue system used to raise a load under control.

3.3.104 "Reach, Throw, Row, Go." The four sequential steps in water rescue with progressively more risk to the rescuer. Specifically, a "go" rescue involves physically entering the medium (e.g., in the water or on the ice).

3.3.105* Reconnaissance (Recon). A preliminary examination or survey; specifically, an examination of an area for the purpose of obtaining information necessary for directing search and rescue operations.

3.3.106 Recovery. Nonemergency operations carried out by responders to retrieve property or remains of victims.

3.3.107* Redundant Air System. A system composed of a compressed breathing gas source, pressure gauge, primary and secondary regulator, and a means of affixing the system to the diver so that it will not be dropped or dislodged; is completely independent of the diver's primary air system and is configured to be accessed without delay when the diver is under duress; and of sufficient capacity to permit the diver to ascend to the surface from the maximum recognized operational depth while complying with a prescribed ascent rate and any necessary safety stops.

3.3.108* Registered Professional Engineer. A person who is registered as a professional engineer in the state where the work is to be performed.

3.3.109 Rescue. Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility.

3.3.110* Rescue Area. An area surrounding the incident site (e.g., collapsed structure or trench) whose size is proportional to the hazards that exist.

3.3.111 Rescue Attendant. A person who is qualified to be stationed outside a confined space to monitor rescue entrants, summon assistance, and perform nonentry rescues.

3.3.112 Rescue Entrant. A person entering a confined space for the specific purpose of rescue.

3.3.113 Rescue Incident. An emergency incident that primarily involves the rescue of persons subject to physical danger and that could include the provision of emergency medical care, but not necessarily.

3.3.114 Rescue Shoring. The temporary stabilization or resupport of any part of, section of, or structural element within a structure which is physically damaged, missing, or where the structure itself is partially or totally collapsed or in danger of collapsing.

3.3.115* Rescue Team. A combination of rescue-trained individuals who are equipped and available to respond to and perform technical rescues.

3.3.116 Rescue Team Leader. The person designated within the incident command system as rescue group/division officer responsible for direct supervision of the rescue team operations.

3.3.117* Retrieval System. Combinations of rescue equipment used for nonentry (external) rescue of persons from confined spaces.

3.3.118 Risk Assessment. An assessment of the likelihood, vulnerability, and magnitude of incidents that could result from exposure to hazards.

3.3.119* Risk/Benefit Analysis. A decision made by a responder based on a hazard identification and situation assessment that weighs the risks likely to be taken against the benefits to be gained for taking those risks.

3.3.120 Rope. A compact but flexible, torsionally balanced, continuous structure of fibers produced from strands that are twisted, plaited, or braided together and that serve primarily to support a load or transmit a force from the point of origin to the point of application. [**1983,** 2017]

3.3.121 Rope Rescue Equipment. Components used to build rope rescue systems including life safety rope, life safety harnesses, and auxiliary equipment.

3.3.122 Rope Rescue System. A system comprised of rope rescue equipment and an appropriate anchor system intended for use in the rescue of a subject.

3.3.123 Safety Officer. An individual appointed by the AHJ as qualified to maintain a safe working environment.

3.3.124 Structural Marking System. A building marking system used to identify and display information related to structure identification, structure hazards evaluation, search assessment, and victim location.

3.3.125 Secondary Access. Openings created by rescuers that provide a pathway to trapped and/or injured victims.

3.3.126* Secondary Search. A detailed, systematic search of an area.

3.3.127 Sheeting. The members of a shoring system that support the sides of an excavation and are in turn supported by other members of the shoring system.

3.3.128* Shield (or Shield System). A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structures.

3.3.129 Shoring Team. The group of individuals, with established communications and leadership, assigned to construct, move, place, and manage the shoring or shoring system inside a structure, space, trench, or excavation.

3.3.130 Single-Point Anchor System. An anchor system configuration utilizing a single anchor point to provide the primary support for the rope rescue system. A single-point anchor system includes those anchor systems that utilize one or more additional nonloaded anchor points as backup to the primary anchor point.

3.3.131 Size-Up. A mental process of evaluating the influencing factors at an incident prior to committing resources to a course of action.

3.3.132 Small Machine. Machinery or equipment capable of simple disassembly, or constructed of lightweight materials, presenting simple hazards, which are capable of being controlled by the rescuer(s).

3.3.133 Software. A flexible fabric component of rope rescue equipment that can include, but is not limited to, anchor straps, pick-off straps, and rigging slings.

3.3.134 Special Operations. Those emergency incidents to which the responding agency responds that require specific and advanced technical training and specialized tools and equipment.

3.3.135 Standard Operating Guideline. An organizational directive that establishes a course of action or policy.

3.3.136 Standard Operating Procedure. A written organizational directive that establishes or prescribes specific operational or administrative methods to be followed routinely for the performance of designated operations or actions. [**1521,** 2015]

3.3.137* Strongback. The vertical members of a trench shoring system placed in contact with the earth, usually held in place against sections of sheeting with shores and positioned so that individual members do not contact each other.

3.3.138* Supplemental Sheeting and Shoring. Sheeting and shoring operations that involve the use of commercial sheeting/shoring systems and/or isolation devices or that involve cutting and placement of sheeting and shoring when greater than 2 ft (0.61 m) of shoring exists below the bottom of the strongback.

3.3.139 Support System. A structure, such as underpinning, bracing, or shoring, that provides support to an adjacent structure, underground installation, or the sides of an excavation.

3.3.140 Surcharge Load. Any weight near the lip of the trench that increases the likelihood of instability or secondary cave-in.

3.3.141 Swift Water. Water moving at a rate greater than one knot [1.15 mph (1.85 km/hr)].

3.3.142* System Safety Factor. The weakest point within a system, expressed as a ratio between the minimum breaking strength of that point (component) as compared to the force placed upon it.

3.3.143 System Stress. Any condition creating excessive force (i.e., exceeding the maximum working load of any component) to components within a rope rescue system that could lead to damage or failure of the system.

3.3.144* Tabulated Data. Any set of site-specific design data used by a professional engineer to design a protective system at a particular location.

3.3.145 Tagout. A method of tagging, labeling, or otherwise marking an isolation device during hazard abatement operations to prevent accidental removal of the device. *(See also 3.3.80, Lockout.)*

3.3.146 Technical Search and Rescue. The application of special knowledge, skills, and equipment to resolve unique and/or complex search and rescue situations.

3.3.147* Technical Search and Rescue Incident. Complex search and/or rescue incidents requiring specialized training of personnel and special equipment to complete the mission.

3.3.148 Tender. An individual trained in the responsibilities of diver safety who provides control of search patterns from the surface of the water.

3.3.149* Terrain. Specific natural and topographical features within an environment.

3.3.150* Terrain Hazard. Specific terrain feature, or feature-related condition, that exposes one to danger and the potential for injury and/or death.

3.3.151* Traditional Sheeting and Shoring. The use of 4 ft × 8 ft (1.2 m × 2.4 m) sheet panels, with a strongback attachment, supplemented by a variety of conventional shoring options such as hydraulic, screw, and/or pneumatic shores.

3.3.152 Transfer Device. Various devices, including litters and harnesses, used with rope rescue systems to package and allow safe removal of a subject from a specific rescue environment.

3.3.153* Trench (or Trench Excavation). A narrow (in relation to its length) excavation made below the surface of the earth.

3.3.154 Trench Box (or Trench Shield). A manufactured protection system unit made from steel, fiberglass, or aluminum that is placed in a trench to protect workers from cave-in and that can be moved as a unit. *[See also 3.3.130, Shield (or Shield System).]*

3.3.155* Tunnel. A covered excavation used for the conveyance of people or materials, typically no smaller than 36 in. (0.91 m) in diameter and within 20 degrees of horizontal.

3.3.156 Vehicle. A device or structure for transporting persons or things; a conveyance.

3.3.157 Watermanship Skills. Capabilities that include swimming, surface diving, treading water, and staying afloat with a reasonable degree of comfort appropriate to the required task.

3.3.158 Webbing. Woven material of flat or tubular weave in the form of a long strip.

3.3.159* Wilderness. A setting in which the delivery of services including search, rescue, and patient care by response personnel is adversely affected by logistical complications, such as an environment that is physically stressful or hazardous to the patient, response personnel, or both; remoteness of the patient's location, such that it causes a delay in the delivery of care to the patient; anywhere the local infrastructure has been compromised enough to experience wilderness-type conditions, such as lack of adequate medical supplies, equipment, or transportation; remoteness from public infrastructure support services; poor to no medical services or potable water; compromised public safety buildings, public utilities or communications systems; city, county, state, provincial, tribal, or national recreational areas or parks with mountains, trails; areas they define as wilderness.

Chapter 4 General Requirements

4.1 General.

4.1.1* The authority having jurisdiction (AHJ) shall establish levels of operational capability needed to conduct operations at technical search and rescue incidents, based on hazard identification, risk assessment, training level of personnel, and availability of internal and external resources.

4.1.2 At a minimum, all technical search and rescue organizations shall meet the awareness level for each type of search and rescue incident for which the AHJ has identified a potential hazard (*see 4.2.1*).

4.1.3* In jurisdictions where identified hazards might require a search and rescue capability at a level higher than awareness, a plan to address this situation shall be written.

4.1.3.1 The AHJ shall determine distribution of roles and responsibilities in order to focus training and resources at the designated level to maintain proficiency.

4.1.3.2 Where an advanced level of search and rescue capability is required in a given area, organizations shall have a system in place to utilize the most appropriate resource(s) available, through the use of local experts, agreements with specialized resources, and mutual aid.

4.1.4 The AHJ shall establish written standard operating procedures (SOPs) consistent with one of the following operational levels for each of the disciplines defined in this document:

(1)* *Awareness Level.* This level represents the minimum capability of organizations that provide response to technical search and rescue incidents.

(2)* *Operations Level.* This level represents the capability of organizations to respond to technical search and rescue incidents and to identify hazards, use equipment, and apply limited techniques specified in this standard to support and participate in technical search and rescue incidents.

(3) *Technician Level.* This level represents the capability of organizations to respond to technical search and rescue incidents and to identify hazards, use equipment, and apply advanced techniques specified in this standard necessary to coordinate, perform, and supervise technical search and rescue incidents.

4.1.5* It is not the intent of this document to have an organization deem itself capable of an advanced skill level in any of the disciplines defined herein simply by training or adhering to the requirements set forth. Maintaining an operations- or technician-level capability in any discipline shall require a

combination of study, training, skill, and frequency of operations in that discipline.

4.1.6 The AHJ shall establish operational procedures consistent with the identified level of operational capability to ensure that technical search and rescue operations are performed in a manner that minimizes threats to rescuers and others.

4.1.7 The same techniques used in a search and rescue operation shall be considered equally useful for training, body recovery, evidence search, and other operations with a level of urgency commensurate with the risk/benefit analysis.

4.1.8 Operational procedures shall not exceed the identified level of capability established in 4.1.4.

4.1.9* At a minimum, medical care at the basic life support (BLS) level shall be provided by the organization at technical search and rescue incidents.

4.1.10 Training.

4.1.10.1 The AHJ shall provide for training in the responsibilities that are commensurate with the operational capability of the organization.

4.1.10.1.1 The minimum training for an organization shall be at the awareness level.

4.1.10.1.2 Organizations expected to perform at a higher operational level shall be trained to that level.

4.1.10.2* The AHJ shall provide for the continuing education necessary to maintain all requirements of the organization's identified level of capability.

4.1.10.3 An annual performance evaluation of the organization based on requirements of this standard shall be performed.

4.1.10.4* The AHJ shall evaluate its training program to determine whether the current training has prepared the organization to function at the established operational level under abnormal weather conditions, extremely hazardous operational conditions, and other difficult situations.

4.1.10.5* Documentation.

4.1.10.5.1 The AHJ shall be responsible for the documentation of all required training.

4.1.10.5.2 This documentation shall be maintained and available for inspection by individual team members and their authorized representatives.

4.1.11 Prior to operating at a technical search and rescue incident, an organization shall meet the requirements specified in Chapter 4 as well as all relevant requirements of Chapters 5 through 9 for the specific technical rescue incident.

4.1.12 Standard Operating Procedure.

4.1.12.1 The AHJ shall ensure that there is a standard operating procedure to evacuate members from an area and to account for their safety when an imminent hazard condition is discovered.

4.1.12.2 This procedure shall include a method to notify all members in the affected area immediately by any effective means, including audible warning devices, visual signals, and radio signals.

4.1.13* The AHJ shall comply with all applicable local, state, tribal, provincial, and federal laws.

4.1.14* The AHJ shall train responsible personnel in procedures for invoking, accessing, and using relevant components of the *U.S. National Search and Rescue Plan*, the FEMA National Response Framework, and other national, state, and local response plans, as applicable.

4.2 Hazard Identification and Risk Assessment.

4.2.1* The AHJ shall conduct a hazard identification and risk assessment of the response area and shall determine the feasibility of conducting technical search and rescue operations.

4.2.2 The hazard identification and risk assessment shall include an evaluation of the environmental, physical, social, and cultural factors influencing the scope, frequency, and magnitude of a potential technical search and rescue incident and the impact they might have on the ability of the AHJ to respond to and to operate while minimizing threats to rescuers at those incidents.

4.2.3* The AHJ shall identify the type and availability of internal resources needed for technical search and rescue incidents and shall maintain a list of those resources.

4.2.4* The AHJ shall identify the type and availability of external resources needed to augment existing capabilities for technical search and rescue incidents and shall maintain a list of these resources, which shall be updated at least once a year.

4.2.5* The AHJ shall establish procedures for the acquisition of those external resources needed for technical search and rescue incidents.

4.2.6 The hazard identification and risk assessment shall be documented.

4.2.7 The hazard identification and risk assessment shall be reviewed and updated on a scheduled basis and as operational or organizational changes occur.

4.2.8 At intervals determined by the AHJ, the AHJ shall conduct surveys in the organization's response area for the purpose of identifying the types of technical search and rescue incidents that are most likely to occur.

4.3 Incident Response Planning.

4.3.1 The procedures for a technical search and rescue emergency response shall be documented in the special operations incident response plan.

4.3.1.1 The plan shall be a formal, written document.

4.3.1.2 Where external resources are required to achieve a desired level of operational capability, mutual aid agreements shall be developed with other organizations.

4.3.2 Copies of the technical search and rescue incident response plan shall be distributed to agencies, departments, and employees having responsibilities designated in the plan.

4.3.3 A record shall be kept of all holders of the technical search and rescue incident response plan, and a system shall be implemented for issuing all changes or revisions.

4.3.4 The technical search and rescue incident response plan shall be approved by the AHJ through a formal, documented

approval process and shall be coordinated with participating agencies and organizations.

4.4 Equipment.

4.4.1 Operational Equipment.

4.4.1.1* The AHJ shall ensure that equipment commensurate with the respective operational capabilities for operations at technical search and rescue incidents and training exercises is provided.

4.4.1.2 Training shall be provided to ensure that all equipment is used and maintained in accordance with the manufacturers' instructions.

4.4.1.3 Procedures for the inventory and accountability of all equipment shall be developed and used.

4.4.2 Personal Protective Equipment (PPE).

4.4.2.1* The AHJ shall ensure that the protective clothing and equipment are supplied to provide protection from those hazards to which personnel are exposed or could be exposed.

4.4.2.2 Personnel shall be trained in the care, use, inspection, maintenance, and limitations of the protective clothing and equipment assigned or available for their use.

4.4.2.3 The AHJ shall ensure that all personnel wear and use PPE while working in known or suspected hazardous areas during technical search and rescue incidents and training exercises.

4.4.2.4 The AHJ shall ensure that atmosphere-supplying respirators in the form of supplied air respirators (SAR) or self-contained breathing apparatus (SCBA) are available when required for technical search and rescue operations and that they meet the requirements specified in Chapter 7 of NFPA 1500.

4.4.2.4.1 Breathing apparatus shall be worn in accordance with the manufacturer's recommendations.

4.4.2.4.2 A supply source of breathing air meeting the requirements of ANSI/CGA G7.1, *Commodity Specification for Air*, with a minimum air quality of Grade D shall be provided for all atmosphere-supplying respirators.

4.4.2.4.3 A supply source of breathing air meeting the requirements of ANSI/CGA G7.1, *Commodity Specification for Air*, with a minimum air quality of Grade E shall be provided for all atmosphere-supplying respirators used for dive operations.

4.4.2.4.4 Supplied air respirators shall be used in conjunction with a self-contained breathing air supply capable of providing enough air for egress in the event of a primary air supply failure.

4.5 Safety.

4.5.1 General.

4.5.1.1 All personnel shall receive training related to the hazards and risks associated with technical search and rescue operations.

4.5.1.2 All personnel shall receive training for conducting search and rescue operations while minimizing threats to rescuers and using PPE.

4.5.1.3 The AHJ shall ensure that members assigned duties and functions at technical search and rescue incidents and training exercises meet the relevant requirements of the following chapters and sections of NFPA 1500:

(1) Section 5.4, Special Operations Training
(2) Chapter 7, Protective Clothing and Protective Equipment
(3) Chapter 8, Emergency Operations

4.5.1.4* Where members are operating in positions or performing functions at an incident or training exercise that pose a high potential risk for injury, members qualified in BLS shall be standing by.

4.5.1.5* Rescuers shall not be armed except when it is required to meet the objectives of the incident as determined by the AHJ.

4.5.2 Safety Officer. At technical search and rescue training exercises and in actual operations, the incident commander shall assign a member to fulfill the duties of a safety officer with the specific technical knowledge and responsibility for the identification, evaluation, and, where possible, correction of hazardous conditions and unsafe practices specific to the operational capabilities employed.

4.5.3 Incident Management System.

4.5.3.1* The AHJ shall provide for and utilize training on the implementation of an incident management system that meets the requirements of NFPA 1561 with written SOPs applying to all members involved in emergency operations. All members involved in emergency operations shall be familiar with the system.

4.5.3.2 The AHJ shall provide for training on the implementation of an incident accountability system that meets the requirements of NFPA 1561.

4.5.3.3 The incident commander shall ensure rotation of personnel to reduce stress and fatigue.

4.5.3.4 The incident commander shall ensure that all personnel are aware of the potential impact of their operations on the safety and welfare of rescuers and others, as well as on other activities at the incident site.

4.5.3.5 At all technical search and rescue incidents, the organization shall provide supervisors who possess skills and knowledge commensurate with the operational level identified in 4.1.4.

4.5.4* Fitness. The AHJ shall ensure that members are psychologically, physically, and medically capable to perform assigned duties and functions at technical search and rescue incidents and to perform training exercises in accordance with Chapter 10 of NFPA 1500.

4.5.5 Nuclear, Biological, and Chemical Response.

4.5.5.1* The AHJ, as part of its hazard identification and risk assessment, shall determine the potential to respond to technical search and rescue incidents that might involve nuclear or biological weapons, chemical agents, or weapons of mass destruction, including those with the potential for secondary devices.

4.5.5.2 If the AHJ determines that a valid risk exists for technical search and rescue response into a nuclear, biological, and/or chemical environment, it shall provide training and equipment for response personnel.

Chapter 5 Rope Rescue

5.1 General Requirements.

5.1.1 Organizations operating at rope rescue incidents shall meet the requirements specified in Chapter 4.

5.1.2* The AHJ shall evaluate the need for missing person search where rope rescues might occur within its response area and shall provide a search capability commensurate with the identified needs.

5.1.3* All techniques required of the rope rescue team within this standard shall be demonstrated by the team and/or team members on at least an annual basis to a level that assures their ability to perform the practice in a manner that will result in rapid access to and successful rescue of the victim while minimizing further injury and without sacrificing the safety of rescue team members.

5.2 Awareness Level.

5.2.1 Organizations operating at the awareness level for rope rescue incidents shall meet the requirements specified in Section 5.2.

5.2.2 Organizations operating at the awareness level for rope rescue incidents shall develop and implement procedures for the following:

(1) Recognizing the need for a rope rescue
(2)* Identifying resources necessary to conduct rope rescue operations
(3)* Carrying out the emergency response system where rope rescue is required
(4)* Carrying out site control and scene management
(5)* Recognizing general hazards associated with rope rescue and the procedures necessary to mitigate these hazards
(6)* Identifying and utilizing PPE assigned for use at a rope rescue incident

5.3 Operations Level.

5.3.1 Organizations operating at the operations level for rope rescue incidents shall meet the requirements specified in Sections 5.2 and 5.3.

5.3.2* Organizations operating at the operations level for rope rescue incidents shall, commensurate with the identified needs of the organization, develop and implement procedures for rescues involving movement of persons from one stable location to another, including, but not limited to, the following:

(1) Sizing up existing and potential conditions at incidents where rope rescue operations will be performed
(2) Assuring safety in rope rescue operations
(3) Establishing the need for, selecting, and placing edge protection
(4) Selecting, using, and maintaining rope rescue equipment and rope rescue systems
(5) Configuring all knots, bends, and hitches used by the organization
(6) Selecting anchor points and equipment to construct anchor systems
(7) Constructing and using single-point anchor systems
(8)* Constructing and using multiple-point anchor systems with regard to the potential increase in force that can be associated with their use
(9)* Selecting, constructing, and using a belay system
(10) Selecting and using methods necessary to negotiate an edge or other obstacle that includes protecting all personnel working nearby from accidental fall
(11) Ascending and descending a fixed line
(12)* Self-rescue
(13)* Selecting, constructing, and using a lowering system in both the low- and high-angle environments
(14) Securing a patient in a litter
(15) Attaching a litter to a rope rescue system and managing its movement
(16)* Selecting, constructing, and using rope-based mechanical advantage haul systems in both the low- and high-angle environments
(17)* Negotiating a loaded litter over an edge during a raising and lowering operation

5.4 Technician Level.

5.4.1 Organizations operating at the technician level for rope rescue incidents shall meet the requirements specified in Sections 5.2, 5.3, and 5.4.

5.4.2* Organizations operating at the technician level for rope rescue incidents shall develop and implement procedures, commensurate with the identified needs of the organization, for the following:

(1)* Accessing a patient using techniques that require rescuers to climb up or down natural or man-made structures, which can expose the climber to a significant fall hazard
(2)* Using rope rescue systems to move a rescuer and a patient along a horizontal path above an obstacle or projection
(3)* Performing a high-angle rope rescue of a person suspended from, or stranded on, a structure or landscape feature
(4) Applying the principles of the physics involved in constructing rope rescue systems, including system safety factors, critical angles, and the causes and effects of force multipliers
(5) Performing a high-angle rope rescue with a litter using tender(s) to negotiate obstacles, manipulate or position the patient, or provide medical care while being raised and lowered

Chapter 6 Structural Collapse Search and Rescue

6.1 General Requirements. Organizations operating at structural collapse incidents shall meet the requirements specified in Chapter 4.

6.2 Awareness Level.

6.2.1 Organizations operating at the awareness level for structural collapse incidents shall meet the requirements specified in Sections 6.2 and 7.2 (awareness level for confined space search and rescue).

6.2.2 Organizations operating at the awareness level for structural collapse incidents shall implement procedures for the following:

(1) Recognizing the need for structural collapse search and rescue
(2)* Identifying the resources necessary to conduct structural collapse search and rescue operations
(3)* Initiating the emergency response system for structural collapse incidents
(4)* Initiating site control and scene management
(5)* Recognizing the general hazards associated with structural collapse incidents, including the recognition of applicable construction types and categories and the expected behaviors of components and materials in a structural collapse
(6)* Identifying the 14 types of collapse patterns and potential victim locations
(7)* Recognizing the potential for secondary collapse
(8)* Conducting visual and verbal searches at structural collapse incidents, while using approved methods for the specific type of collapse
(9)* Recognizing and implementing a search and rescue/search assessment marking system, building marking system (structure/hazard evaluation), victim location marking system, and structure marking system (structure identification within a geographic area), such as the ones used by the FEMA National Urban Search and Rescue Response System
(10) Removing readily accessible victims from structural collapse incidents
(11)* Identifying and establishing a collapse safety zone
(12)* Conducting reconnaissance (recon) of the structure(s) and surrounding area

6.3 Operations Level.

6.3.1 Organizations operating at the operations level for structural collapse incidents shall meet the requirements specified in Sections 6.2 and 6.3 as well as those in the following sections:

(1) Section 5.3 (operations level for rope rescue)
(2) Section 7.3 (operations level for confined space search and rescue)
(3) Section 11.3 (operations level for trench and excavation search and rescue)
(4) Section 8.3 (operations level for vehicle search and rescue)
(5) Section 16.2 (awareness level for surface water search and rescue)
(6) Section 12.3 (operations level for machinery search and rescue)

6.3.2 The organization shall have members capable of recognizing hazards, using equipment, and implementing techniques necessary to operate at structural collapse incidents involving the collapse or failure of ordinary construction (light frame, unreinforced masonry construction, and reinforced masonry construction).

6.3.3 Organizations operating at the operations level for structural collapse incidents involving light frame ordinary construction and reinforced and unreinforced masonry construction shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at structural collapse incidents
(2)* Recognizing unique collapse or failure hazards
(3)* Conducting hasty primary and secondary search operations (low and high coverage) intended to locate victims trapped on, inside, and beneath collapse debris
(4)* Accessing victims trapped inside and beneath collapse debris
(5)* Performing extrication operations involving packaging, treating, and removing victims trapped within and beneath collapse debris
(6)* Stabilizing the structure and performing rescue shoring operations using shores that include T shore, double T shore, two-post vertical shore, multiple-post vertical shore, door and window shore, horizontal shore, flying raker shore, split sole raker shore, solid sole raker shore, and box cribbing to make safe for rescue operations

6.4 Technician Level.

6.4.1 Organizations operating at the technician level for structural collapse incidents shall meet the requirements specified in this chapter and the following sections:

(1) Section 5.4 (technician level for rope rescue)
(2) Section 7.4 (technician level for confined space search and rescue)
(3) Section 11.4 (technician level for trench and excavation search and rescue)
(4) Section 8.4 (technician level for vehicle search and rescue)
(5) Section 12.4 (technician level for machinery search and rescue)

6.4.2 The organization shall have members capable of recognizing hazards, using equipment, and implementing techniques necessary to operate at structural collapse incidents involving all types of construction.

6.4.3 Organizations operating at the technician level for structural collapse incidents for all types of construction shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at structural collapse incidents
(2) Recognizing unique collapse or failure hazards
(3)* Conducting search operations intended to locate victims trapped inside and beneath collapse debris
(4)* Accessing victims trapped inside and beneath collapse debris
(5)* Performing extrication operations involving packaging, treating, and removing victims trapped within and beneath collapse debris
(6)* Stabilizing the structure and performing rescue shoring operations using shores that include laced post shore, plywood laced post shore, sloped floor shores (Type 2 and Type 3), double raker shore, and flying shore to make safe for rescue operations

Chapter 7 Confined Space Search and Rescue

7.1 General Requirements.

7.1.1 Organizations operating at confined space incidents shall meet the requirements specified in Chapter 4.

7.1.2* The requirements of this chapter shall apply to organizations that provide varying degrees of response to confined space emergencies.

7.1.3* The rescue service shall be capable of responding in a timely manner to rescue summons.

7.2 Awareness Level.

7.2.1 Organizations operating at the awareness level for confined space search and rescue incidents shall meet the requirements specified in Sections 7.2 and 5.2 (awareness level for rope rescue).

7.2.2 The organization shall have an appropriate number of personnel meeting the requirements of Chapter 4 of NFPA 472 commensurate with the organization's needs.

7.2.3 Organizations at the awareness level shall be responsible for performing certain nonentry rescue (retrieval) operations.

7.2.4 Organizations operating at the awareness level for confined space search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for confined space search and rescue
(2) Initiating contact and establishing communications with victims where possible
(3)* Recognizing and identifying the hazards associated with nonentry confined space emergencies
(4)* Recognizing confined spaces
(5)* Performing a nonentry retrieval
(6)* Implementing the emergency response system for confined space emergencies
(7)* Implementing site control and scene management

7.3 Operations Level.

7.3.1 Organizations operating at the operations level for confined space search and rescue incidents shall meet the requirements specified in Sections 7.2, 7.3, and 5.3 (operations level for rope rescue).

7.3.2 The organization operating at this level shall be responsible for the development and training of a confined space rescue service that is trained, equipped, and available to respond to confined space emergencies of a type and complexity that require an operations-level organization.

7.3.2.1* The role of a confined space rescue service is intended to include entry into the space to perform a rescue and, as a minimum, shall be staffed to provide sufficient members with the following exclusive functions:

(1)* Rescue entrant/entry team of sufficient size and capability to perform the rescue
(2)* Backup rescue entrants of a sufficient number to provide immediate assistance to, or rescue of, rescue entrants who become ill or injured and are unable to perform self-rescue
(3) Rescue attendant whose function is to deny unauthorized persons access and to monitor the conditions in the space and the status of all entrants
(4) Rescue team leader (supervisor) whose function is to maintain control of the entire operation and be knowledgeable in all rescue service functions

7.3.2.2 Operations-level organizations shall be restricted to rescue inside confined spaces with the following characteristics:

(1)* Where the internal configuration of the space is clear and unobstructed so retrieval systems can be used for rescuer entrants without possibility of entanglement
(2)* Where the victim can be easily seen from the outside of the space's primary access opening
(3)* Where rescue entrants can pass easily through the access/egress opening(s) with room to spare when PPE is worn in the manner recommended by the manufacturer
(4)* Where the space can accommodate two or more rescue entrants in addition to the victim
(5)* Where all hazards in and around the confined space have been identified, isolated, and controlled

7.3.3 The operations-level organization shall ensure that each member of the rescue service meets the minimum requirements of operations-level confined space rescue in NFPA 1006.

7.3.4 If required to provide confined space rescue within regulated industrial facilities, the organization shall ensure the rescue service has access to all confined spaces from which rescue could be necessary so that they can develop rescue plans and practice rescue operations according to their designated level of competency.

7.3.5* The organization shall ensure that each member of the rescue service practices making confined space rescues once every 12 months, in accordance with the requirements of 4.1.10 of this document, by means of simulated rescue operations in which he or she removes dummies, mannequins, or persons from actual confined spaces or from representative confined spaces resembling all those to which the rescue service could be required to respond in an emergency within their jurisdiction. Representative confined spaces shall — with respect to opening size, configuration, and accessibility — simulate the types of confined spaces from which rescue is to be performed.

7.3.6 Organizations operating at the operations level shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at confined space emergencies
(2)* Protecting rescue personnel from hazards within and adjacent to the confined space
(3)* Ensuring that rescue personnel are capable of managing the physical and psychological challenges that affect rescuers entering confined spaces
(4)* Identifying the duties of the rescue entrant(s) and backup rescue entrant(s), rescue attendant, and rescue team leader as defined herein
(5)* Monitoring continuously, or at frequent intervals, the atmosphere in all parts of the space to be entered for oxygen content, flammability [lower explosive limit/lower flammable limit (LEL/LFL)], and toxicity, in that order
(6)* Performing entry-type rescues into confined spaces
(7)* Using victim packaging devices that could be employed in large, unobstructed confined spaces
(8)* Selecting, constructing, and using a rope-based lowering and -raising system in the high-angle environment

7.4 Technician Level.

7.4.1 Organizations operating at the technician level for confined space search and rescue emergencies shall meet the requirements of this chapter and Section 12.2 (awareness level for machinery search and rescue).

7.4.2 The organization operating at this level shall be responsible for the development of a confined space rescue service that is trained, equipped, and available to respond to emergen-

cies within confined spaces of a type and complexity that requires a technician-level organization.

7.4.2.1 A technician-level rescue service shall be required for confined spaces with one or more of the following characteristics:

(1) Where the internal configuration of the space might create entanglement hazards and retrieval might not be effective
(2) Where the victim cannot be seen from the outside of the space's primary access opening
(3) Where the portal size and configuration will not allow a rescuer to pass through the access/egress opening(s) using SCBA when worn in the manner recommended by the manufacturer
(4) Where all hazards in and around the confined space have been identified and can be mitigated by using respiratory protection

7.4.3 Organizations operating at the technician level for confined space search and rescue emergencies shall develop and implement procedures for the following:

(1) Developing hazard isolation and control requirements
(2)* Planning response for entry-type rescues in hazardous environments
(3)* Implementing the planned response
(4) Using victim packaging devices suitable for confined spaces with small entry portals and/or that are internally congested

Chapter 8 Vehicle Search and Rescue

8.1* General Requirements. Organizations operating at vehicle search and rescue incidents shall meet the requirements specified in Chapter 4.

8.2 Awareness Level.

8.2.1 Organizations operating at the awareness level for vehicle emergencies shall meet the requirements specified in Section 8.2.

8.2.2 All members of the organization shall meet the requirements specified in Chapter 4 of NFPA 472 commensurate with the organization's needs.

8.2.3 Organizations operating at the awareness level for vehicle emergencies shall implement procedures for the following:

(1) Recognizing the need for a vehicle search and rescue
(2)* Identifying the resources necessary to conduct operations
(3)* Initiating the emergency response system for vehicle search and rescue incidents
(4)* Initiating site control and scene management
(5)* Recognizing general hazards associated with vehicle search and rescue incidents
(6) Initiating traffic control

8.3 Operations Level.

8.3.1 Organizations operating at the operations level for vehicle emergencies shall meet the requirements specified in Sections 8.2 and 8.3.

8.3.2 All members of the organization shall meet the requirements of Chapter 5 of NFPA 472 commensurate with the organization's needs.

8.3.3* The organization shall have members capable of recognizing hazards, using equipment, and implementing techniques necessary to operate safely and effectively at incidents involving persons injured or entrapped in a typical vehicle commonly found in the jurisdiction.

8.3.4 Organizations operating at the operations level for vehicle emergencies shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at vehicle search and rescue incidents
(2) Identifying probable victim locations and survivability
(3)* Making the search and rescue area safe, including identifying and controlling the hazards presented by the vehicle, its position, or its systems
(4)* Identifying, containing, and stopping fuel release
(5) Protecting a victim during extrication or disentanglement
(6) Packaging a victim prior to extrication or disentanglement
(7)* Accessing victims trapped in a typical vehicle commonly found in the jurisdiction
(8)* Performing extrication and disentanglement operations involving packaging, treating, and removing victims trapped in a common passenger vehicle, or other types of vehicles as identified by the AHJ as being commonly found in the jurisdiction, through the use of hand and power tools
(9)* Mitigating and managing general and specific hazards associated with vehicle search and rescue incidents that involve common passenger vehicles or other vehicles typically found in the jurisdiction
(10) Procuring and utilizing the resources necessary to conduct vehicle search and rescue operations
(11) Maintaining control of traffic at the scene of vehicle search and rescue incidents

8.3.5 Any member of the organization who could be expected to perform at the operations level for vehicle search and rescue shall be provided training to meet the job performance requirements for operations-level vehicle rescue as defined in NFPA 1006.

8.4 Technician Level.

8.4.1 Organizations operating at the technician level for vehicle emergencies shall meet the requirements specified in Chapter 8.

8.4.2 Organizations operating at the technician level for vehicle emergencies shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at vehicle search and rescue incidents
(2)* Performing extrication and disentanglement operations involving packaging, treating, and removing victims injured or trapped in large commercial or industrial vehicles or any vehicles that present unique, complex, exotic, or unfamiliar hazards or extrication challenges
(3)* Stabilizing in advance of technician-level vehicle search and rescue situations
(4)* Using all specialized search and rescue equipment immediately available and in use by the organization
(5) Using specialized outside resources, including heavy equipment

8.4.3 Any member of the organization who could be expected to perform at the technician level for vehicle search and rescue shall be provided training to meet the job performance requirements for technician-level vehicle rescue as defined in NFPA 1006.

Chapter 9 Animal Technical Rescue

9.1* General Requirements.

9.1.1 Organizations operating at animal rescue incidents shall meet the requirements specified in Chapter 4.

9.1.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

9.2 Awareness Level.

9.2.1 Organizations operating at the awareness level for animal rescue incidents shall meet the requirements specified in Section 9.2.

9.2.2 Organizations at the awareness level for animal rescues in situations covered within this document shall also meet the requirements of those specific chapters at the awareness level.

9.2.3 Organizations operating at the awareness level for animal rescue incidents shall develop and implement procedures for the following:

(1) Recognizing the need for an animal rescue, including differentiating between operations and technician-level response
(2) Identifying resources necessary to conduct animal rescue operations
(3) Carrying out the emergency response system where animal rescue operations are required
(4) Carrying out site control and scene management; to include mitigating hazards presented by animals and how to contain them in all phases of the incident; to include portable fencing, cages, traps, or other equipment as available
(5) Recognizing general hazards associated with animal rescue operations and the procedures necessary to mitigate these hazards
(6) Identifying and utilizing PPE assigned for use at an animal rescue incident
(7) Requesting the appropriate assistance to determine if a technical rescue vs. recovery will be conducted
(8) Recognizing and identifying the special equipment and personnel used in animal rescue incidents
(9) Understanding the social, political, and public safety issues related to effective animal rescue services
(10) Recognizing hazmat considerations involving animal rescue and requesting resources to deal with those issues

9.3 Operations Level.

9.3.1 Organizations performing animal rescue at the operations level shall meet all requirements of Sections 5.3 (operations level for rope rescue), 9.2, and 9.3.

9.3.2 Organizations performing animal rescue for animals not readily accessible shall meet all requirements of Sections 5.3 (operations level for rope rescue), 9.2, and 9.3.

9.3.3 Organizations at the operations level performing animal rescue in situations covered within this document shall also meet the requirements of those specific chapters at the operations level.

9.3.4 Organizations operating at the operations level for animal rescue incidents shall, commensurate with the identified needs of the organization, develop and implement procedures for the following:

(1) Identifying hazards to rescuers posed by the animal (perform risk assessment)
(2) Identifying behavioral body posture cues to determine the disposition of the animal
(3) Creating an improvised restraint device establish physical restraint/control of an animal, both ambulatory and nonambulatory
(4) Identifying appropriate attachment points to the animal and appropriate positioning of the animal for extrication with minimal injury to the animal and responders
(5) Using a harness, halter, leash, webbing, sack, or cage, whether improvised, custom, or commercially manufactured, to assist in the movement of an ambulatory animal from one stable location to another in a low-angle environment
(6) Using an animal packaging device or system to move a recumbent animal from one stable location to another in a low-angle environment
(7) Performing a low-angle and high-angle lower and raise of an animal using an improvised, custom, or commercially manufactured system, to include safely accessing, managing, and packaging the patient
(8) Recognizing when chemical restraint is needed or contraindicated and requesting if needed
(9) In rescues from soil or other adhesive material environments, recognizing the need to alleviate suction on an animal's limbs
(10) Using behavioral cues and "fight or flight" or "tipping point" behavior characteristics to assist in a rescue
(11) Using containment techniques for animals that cannot be immediately handled or which require greater control and attention to behavior
(12) Using a ladder to access animals from a location below or above grade
(13) Using auxiliary equipment to facilitate the safe placement of rescue devices on the animal
(14) Constructing and operating a portable high-point anchor system
(15) Mitigating the hazards to animals and responders in trailer extrication

9.4 Technician Level.

9.4.1 Organizations performing animal rescue at the technician level shall meet all requirements of Sections 5.4 (technician level for rope rescue), 9.2, 9.3, and 9.4.

9.4.2 Organizations performing animal rescue at the technician level for animals not readily accessible shall meet all requirements of Sections 5.4 (technician level for rope rescue), 9.2, 9.3, and 9.4.

9.4.3 Organizations at the technician level performing animal rescue in situations covered within this document shall also meet the requirements of those specific chapters at the level appropriate for the situation.

9.4.4 Organizations at the technician level performing animal rescue of animals that have broken through ice on frozen bodies of water shall develop and implement procedures for

cutting a path through ice and providing water rescue or performing a sideways drag with edge protection or cantilevering of the animal to safety.

9.4.5 Organizations operating at the technician level for animal rescue incidents shall develop and implement procedures, commensurate with the identified needs of the organization, for the following:

(1) Using a designed and tested harness device designed for animals and extended use in the high-angle environment to include helicopter rescue
(2) Performing a high-angle rope rescue of an animal suspended from, or stranded on, a structure or landscape feature
(3) Using rope rescue systems to move an animal along a horizontal path above an obstacle or projection
(4) Applying the principles of the physics involved in constructing rope rescue systems, including system safety factors, critical angles, and the causes and effects of force multipliers
(5) Performing a high-angle rope rescue with an animal litter or sling system using tender(s) to negotiate obstacles or manipulate or position the animal
(6) Moving an animal packaged in an animal litter or sling system up and over an edge during a raising or vertical lift operation with a rope system
(7) Mitigating all dynamic loads associated with animal behaviors in a rope rescue system
(8) Performing helicopter rescue with a specifically designed extended lift harness

Chapter 10 Wilderness Search and Rescue

10.1 General Requirements. Organizations operating at wilderness search and rescue incidents shall meet the requirements specified in Chapter 4.

10.1.1* The AHJ, as part of its hazard identification and risk assessment *(see 4.2.2)*, shall identify all locations and situations in the jurisdiction that meet the definition of *wilderness*.

10.2 Awareness Level.

10.2.1 Organizations operating at the awareness level at wilderness search and rescue incidents shall meet the requirements specified in Section 10.2.

10.2.2 Members of organizations at the awareness level shall be permitted to assist in support functions on a wilderness search and rescue operation but shall not be deployed into the wilderness.

10.2.3 Organizations operating at the awareness level at any wilderness search and rescue incident shall have the following capabilities:

(1) Recognizing the need for a wilderness search and rescue–type response
(2)* Initiating the emergency response system for wilderness search and rescue
(3)* Initiating site control and scene management
(4)* Recognizing the general hazards associated with wilderness search and rescue incidents
(5) Recognizing the type of terrain involved in wilderness search and rescue incidents
(6)* Recognizing the limitations of conventional emergency response skills and equipment in various wilderness environments
(7)* Initiating the collection and recording of information necessary to assist operational personnel in a wilderness search and rescue
(8)* Identifying and isolating any reporting parties and witnesses

10.3 Operations Level.

10.3.1 Organizations operating at the operations level at wilderness search and rescue incidents shall meet the requirements specified in Sections 10.2 and 10.3, as well as those in Section 5.3 (operations level for rope rescue).

10.3.2* The AHJ shall establish standard operating procedures (SOPs) that identify the specific environments in which operations-level organizations shall be permitted to operate.

10.3.3 Organizations operating at the operations level at wilderness search and rescue incidents shall be trained and equipped to operate in the following environments:

(1) Where the general location of the subject is known
(2) Where travel is limited to walking along trails or uneven or off-trail terrain
(3) Where water obstacles, if present, are no more than 2 ft (0.61 m) deep
(4) Where terrain is negotiable without undue exposure
(5) Where terrain is walkable and can be negotiated without scrambling or climbing
(6) Where the incident spans one operational period of 8 hours or less
(7) Where routes are obvious, and specialized map skills are not required
(8) Where travel might involve low-angle travel or patient evacuation on slopes where a rope system could be used for safety but not for suspension
(9) Where weather conditions are stable and do not pose a hazard for rescuers or subject
(10) Where environmental conditions, such as altitude, snow and scree slopes, exposure, and other terrain factors do not pose a hazard to rescuers or subjects

10.3.4 Organizations operating at the operations level at wilderness search and rescue incidents shall be capable of the following:

(1)* Sizing up existing and potential conditions at incidents where wilderness search and rescue will be performed
(2)* Requesting and interfacing with wilderness search and rescue resources
(3) Providing the specialized medical care and protocols that are unique to the wilderness environment
(4)* Using personal survival, body management, and preparedness skills for the specific wilderness environments in which the rescuer could become involved
(5) Operating for an 8-hour period without support
(6) Recognizing the need for, and procedures and equipment for the provision of, environmental protection through clothing systems applicable to the specific wilderness environments in which the rescuer could become involved
(7)* Selecting, caring for, and using personal medical and support equipment and packing it with due regard to how it will be carried

(8) Conducting an interview of a reporting party; documenting and transmitting pertinent information
(9) Recognizing and preserving evidence at a point last seen (PLS) or a last known point (LKP)
(10) Locating a subject in the operational environment based on reporting party information when the general location of the subject is known
(11)* Traveling through various wilderness environments in which the rescuer could become involved while minimizing threats to safety
(12)* Using land navigation techniques on well-marked terrain that include map and compass as well as any methods of navigation and position reporting used by the responding organizations with which the organization could become involved
(13) Procuring the necessary maps and navigational and topographical information
(14) Modifying actions and urgency as applicable to a rescue versus a recovery
(15) Acquiring information on current and forecast environmental factors, including weather, temperature, precipitation, winds, avalanche risk, and tide levels
(16)* Participating in and supporting wilderness search operations intended to locate victims whose exact location is unknown
(17) Accessing, packaging, and caring for a patient in the operational environment
(18) Recognizing, identifying, and utilizing the rescue hardware and software used by the responding organizations with which the organization could become involved
(19) Working in and around any aircraft, watercraft, and special vehicles used for SAR operations while minimizing threats to rescuers
(20) Integrating specialized transport into the operational environment
(21)* Recognizing the organization's limitations regarding accessing and/or evacuating a victim
(22) Recognizing when the incident requires a technician-level response or when other specialized resources are required

10.4 Technician Level.

10.4.1 Organizations operating at the technician level at wilderness search and rescue incidents shall meet the requirements specified in this chapter and the following sections:

(1) Section 5.4 (technician level for rope rescue)
(2) Section 16.2 (awareness level for surface water search and rescue)
(3) Section 15.2 (awareness level for helicopter search and rescue)

10.4.2* Each member of the wilderness search and rescue organization at the technician level shall be trained to, as a minimum, a mountain rescue association team member or the equivalent.

10.4.3 Organizations operating at the technician level shall be capable of performing and supervising all aspects of wilderness search and rescue operations with which the organization could become involved.

10.4.4 Wilderness search and rescue organizations at the technician level shall not be required to develop and maintain capabilities in all types of wilderness search and rescue operations (e.g., search, cave, alpine). The ability of the organization to respond at the technician level in one type of wilderness search and rescue operation shall not imply the ability to respond at the technician level in all types of wilderness search and rescue operations.

10.4.5 Organizations operating at the technician level at wilderness search and rescue incidents shall be capable of operating in the following environments in which special search and rescue training and equipment are required or where the capabilities of operations-level equipment and training are exceeded:

(1) Where the general location of the subject might or might not be known
(2) Where an extensive search and rescue capabilities are required
(3) That might involve terrain that requires difficult scrambling or climbing
(4) That might involve water deeper that 2 ft (0.61 m)
(5) That might involve terrain that is difficult if exposed or dangerous and requires special skills for travel
(6) That might involve terrain that requires technical rock- or snow-climbing skills and equipment or other rope access techniques
(7) Where the incident might span more than one operational period of 8 hours
(8) Where locating routes requires the use of navigational technology
(9) That might involve travel or patient evacuation on steep to vertical slopes where rope systems are essential for security or suspension
(10) That might involve weather conditions that require specialized clothing, travel methods, and equipment
(11) Where environmental conditions, such as altitude, snow or scree slopes, exposure, and other terrain factors require specialized clothing, travel methods, and equipment

10.4.6 Organizations operating at the technician level at wilderness search and rescue incidents shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at incidents where wilderness search and rescue will be performed and determining the need for technician-level teams
(2) Acquiring, using, and coordinating technician-level wilderness search and rescue resources
(3) Providing input to standard operating procedures for anticipated wilderness responses
(4)* Initiating and, where qualified, coordinating and performing technician-level wilderness search and rescue operations
(5)* Writing and using an operational plan for search and rescue in the extreme environment

10.4.7* The AHJ shall base the specialized training and equipment that is required for its jurisdiction on the following factors:

(1) Temperature
(2) Weather
(3) Terrain
(4) Flora and fauna
(5) Altitude
(6) Travel time
(7) Patient care issues
(8) Duration of incident
(9) Logistics

(10) Communications
(11) Navigation
(12) Management needs

10.4.8 Organizations operating at the technician level at wilderness search and rescue incidents shall be capable of the following:

(1) Conducting an interview of a reporting party; documenting and transmitting pertinent information
(2) Recognizing and preserving evidence at a point last seen (PLS) or a last known point (LKP)
(3) Operating for a 24-hour period without support
(4) Navigating with specialized navigation equipment
(5) Locating a subject in the operational environment based on reporting party information when the general location of the subject might or might not be known
(6) Packaging, transporting, and caring for a patient in the operational environment
(7) Determining when other specialized resources are required
(8) Knowing the specialized resources available to the jurisdiction

Chapter 11 Trench Search and Rescue

11.1 General Requirements. Organizations operating at trench and excavation search and rescue incidents shall meet the requirements specified in Chapter 4.

11.2 Awareness Level.

11.2.1 Organizations operating at the awareness level at trench and excavation emergencies shall meet the requirements specified in Sections 11.2 and 7.2 (awareness level for confined space search and rescue).

11.2.2 Each member of the organization shall meet the requirements specified in Chapter 4 of NFPA 472 and shall be a competent person as defined in 3.3.21.

11.2.3 Organizations operating at the awareness level at trench and excavation emergencies shall implement procedures for the following:

(1) Recognizing the need for a trench and excavation rescue
(2)* Identifying the resources necessary to conduct safe and effective trench and excavation emergency operations
(3)* Initiating the emergency response system for trenches and excavations
(4)* Initiating site control and scene management
(5)* Recognizing general hazards associated with trench and excavation emergency incidents and the procedures necessary to mitigate these hazards within the general rescue area
(6)* Recognizing typical trench and excavation collapse patterns, the reasons trenches and excavations collapse, and the potential for secondary collapse
(7)* Initiating a rapid, nonentry extrication of noninjured or minimally injured victim(s)
(8)* Recognizing the unique hazards associated with the weight of soil and its associated entrapping characteristics
(9) Making the rescue area safe, including the identification, construction, application, limitations, and installation of ground pads around the affected collapse or rescue area

11.3 Operations Level.

11.3.1 Organizations operating at the operations level at trench and excavation emergencies shall meet the requirements specified in Sections 11.2 and 11.3, as well as the following sections:

(1) Section 5.3 (operations level for rope rescue)
(2) Section 7.3 (operations level for confined space search and rescue)
(3) Section 8.3 (operations level for vehicle and machinery search and rescue)

11.3.2* Members shall be capable of recognizing the hazards of using equipment and operating at trench and excavation emergencies that include the collapse or failure of individual, nonintersecting trenches with an initial depth of 8 ft (2.4 m) or less under the following conditions:

(1) No severe environmental conditions exist.
(2) Digging operations do not involve supplemental sheeting and shoring.
(3) Only traditional sheeting and shoring are used.

11.3.3 Organizations operating at the operations level at trench and excavation emergencies shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at trench and excavation emergencies
(2) Initiating entry into a trench or excavation rescue area
(3)* Recognizing unstable areas associated with trench and excavation emergencies and adjacent structures
(4)* Identifying probable victim locations and survivability
(5)* Making the rescue area safe, including the identification, construction, application, limitations, and removal of traditional sheeting and shoring using tabulated data and approved engineering practices
(6)* Initiating a one-call utility location service
(7)* Identifying soil types using accepted visual or manual tests
(8) Ventilating the trench or excavation space
(9) Identifying and recognizing a bell-bottom pier hole excavation and its associated unique hazards
(10) Placing ground pads and protecting the "lip" of a trench or excavation
(11)* Providing entry and egress paths for entry personnel
(12)* Conducting a pre-entry briefing
(13)* Initiating record keeping and documentation during entry operations
(14) Selecting, utilizing, and applying shield systems
(15)* Selecting, utilizing, and applying sloping and benching systems
(16) Identifying the duties of panel teams, entry teams, and shoring teams
(17) Assessing the mechanism of entrapment and the method of victim removal
(18)* Performing extrication

11.4 Technician Level.

11.4.1 Organizations operating at the technician level at trench and excavation emergencies shall meet the requirements specified in this chapter and the following sections:

(1) Section 7.4 (technician level for confined space search and rescue)
(2) Section 8.4 (technician level for vehicle and machinery search and rescue)

11.4.2* Members shall be capable of recognizing hazards, using equipment, and operating at trench and excavation emergencies that include the collapse or failure of individual or intersecting trenches with an initial depth of more than 8 ft (2.4 m) or where severe environmental conditions exist, digging operations involve supplemental sheeting and shoring, or manufactured trench boxes or isolation devices would be used.

11.4.3 Organizations operating at the technician level at trench and excavation emergencies shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at trench and excavation emergencies
(2)* Identifying, constructing, and removing manufactured protective systems consistent with the application and limitations of such systems using tabulated data and approved engineering practices
(3)* Monitoring continuously or at frequent intervals the atmosphere in all parts of the trench to be entered for oxygen content, flammability (LEL/LFL), and toxicity, in that order
(4) Identifying the construction, application, limitations, and removal of supplemental sheeting and shoring systems designed to create approved protective systems
(5) Adjusting the protective systems based on digging operations and environmental conditions
(6)* Rigging and placement of isolation systems

Chapter 12 Machinery Search and Rescue

12.1* General Requirements. Organizations operating at machinery search and rescue incidents shall meet the requirements specified in Chapter 4.

12.2 Awareness Level.

12.2.1 Organizations operating at the awareness level for machinery emergencies shall meet the requirements specified in Section 12.2.

12.2.2 All members of the organization shall meet the requirements specified in Chapter 4 of NFPA 472 commensurate with the organization's needs.

12.2.3 Organizations operating at the awareness level for machinery emergencies shall implement procedures for the following:

(1) Recognizing the need for a machinery search and rescue
(2)* Identifying the resources necessary to conduct operations
(3)* Initiating the emergency response system for machinery search and rescue incidents
(4)* Initiating site control and scene management
(5)* Recognizing general hazards associated with machinery search and rescue incidents

12.3 Operations Level.

12.3.1 Organizations operating at the operations level for machinery emergencies shall meet the requirements specified in Sections 12.2 and 12.3.

12.3.2 All members of the organization shall meet the requirements of Chapter 5 of NFPA 472 commensurate with the organization's needs.

12.3.3 The organization shall have members capable of recognizing hazards, using equipment, and implementing techniques necessary to operate safely and effectively at incidents involving persons injured or entrapped in a small machine. (*Refer to the definition for small machine in NFPA 1006.*)

12.3.4 Organizations operating at the operations level for machinery emergencies shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at machinery search and rescue incidents
(2) Identifying probable victim locations and survivability
(3)* Making the search and rescue area safe, including the stabilization and isolation (e.g., lockout/tagout) of all machinery involved
(4)* Identifying and controlling the hazards presented by the release of fluids as gases associated with the machinery, which include, but are not limited to, fuel, cutting or lubricating oil, and cooling water
(5) Protecting a victim during extrication or disentanglement
(6) Packaging a victim prior to extrication or disentanglement
(7) Accessing victims trapped in machinery
(8)* Performing extrication and disentanglement operations involving packaging, treating, and removing victims trapped in machinery where the entrapment is limited to digits or where the machine can be simply disassembled, or is constructed of lightweight materials that can be cut, spread, or lifted and has only simple hazards that are readily controlled
(9)* Mitigating and managing general and specific hazards associated with machinery search and rescue incidents
(10) Procuring and utilizing the resources necessary to conduct machinery search and rescue operations
(11)* Identifying potential emergency events in buildings where mechanical equipment exists, such as elevators, and developing preplans

12.3.5 Rescue members shall make provisions for fall prevention or protection for both rescuers and subjects when working in areas where potential falls can occur.

12.3.6 Any member of the organization who could be expected to perform at the operations level for machinery search and rescue shall be provided training to meet the job performance requirements for operations-level machinery search and rescue as defined in NFPA 1006.

12.4 Technician Level.

12.4.1 Organizations operating at the technician level for machinery emergencies shall meet the requirements specified in this chapter.

12.4.2 Organizations operating at the technician level for machinery emergencies shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at machinery search and rescue incidents
(2)* Performing extrication and disentanglement operations from large machines
(3)* Stabilizing machines and their components at machinery search and rescue incidents
(4)* Using all specialized search and rescue equipment immediately available and in use by the organization

(5)* Removing the occupants of a stranded elevator by way of the car doors when the floor of the elevator is more than 3 ft (91.44 cm) from any floor served, the top hatch, or a service door or when occupants or rescuers are otherwise exposed to the hazards of the inside of the shaft or the machinery to propel the elevator

12.4.3* In elevator rescue, when there are other elevators operating in a common hoistway, all adjacent elevator(s) shall be cleared of passenger(s) and positioned alongside of the stalled elevator.

12.4.4* Adjacent elevators that share a common hoistway shall be secured and prevented from unintentional movement whenever rescuers or victims are exposed to the movement of cars or counterweights in the shaft.

12.4.5 Any member of the organization who could be expected to perform at the technician level for machinery search and rescue shall be provided training to meet the job performance requirements for technician-level machinery search and rescue as defined in NFPA 1006.

Chapter 13 Cave Search and Rescue

13.1 General Requirements. Organizations operating at cave search and rescue incidents shall meet the requirements specified in Chapter 4.

13.1.1 The AHJ, as part of its hazard identification and risk assessment *(see 4.2.2)*, shall identify locations and situations in the jurisdiction that meet the definition of *cave*.

13.2 Awareness Level.

13.2.1 Organizations operating at the awareness level at cave search and rescue incidents shall meet the requirements specified in Section 13.2.

13.2.2 Members of organizations at the awareness level shall be permitted to assist in support functions on a cave search and rescue operation but shall not be deployed into the cave.

13.2.3 Organizations operating at the awareness level at any cave incident shall implement procedures for the following:

(1) Recognizing the need for a cave search and rescue
(2)* Recognizing the limitations of conventional emergency response skills and equipment in various cave environments
(3)* Initiating the emergency response system for cave search and rescue
(4) Initiating site control and scene management
(5)* Recognizing the general hazards associated with cave search and rescue incidents
(6)* Establishing control of all cave entrances
(7)* Initiating the collection and recording of information necessary to assist operational personnel in a cave search and rescue
(8)* Identifying and isolating any reporting parties and witnesses

13.2.4 Each member of the cave rescue organization at the awareness level shall train to a minimum of Orientation to Cave Rescue as defined by the National Cave Rescue Commission of the National Speleological Society or equivalent.

13.3 Operations Level.

13.3.1 Organizations operating at the operations level at cave search and rescue incidents shall meet the requirements specified in Sections 13.2 and 13.3, as well as those in Section 5.3 (operations level for rope rescue).

13.3.2 Organizations operating at the operations level in cave search and rescue shall be under the supervision of organizations at the technician level when operating in a cave environment where technician-level skills are required.

13.3.2.1* Organizations operating at the operations level at cave search and rescue incidents shall be trained and equipped to operate in situations where all of the following conditions are true:

(1) Where the general location of the subject is known
(2) Where movement through the passage is not more difficult than walking or crawling or moving over uneven surfaces
(3) Where water obstacles, if present, are no more than 2 ft (0.61 m) deep
(4) Where cave passage is easily negotiable without undue exposure
(5) Where cave passage is open and can be negotiated without squeezing through tight or constricted spaces
(6) Where travel or transport does not involve fragile cave environments
(7) Where the incident spans an operational period of no more than 8 hours
(8) Where routes are obvious, and specialized map skills are not required
(9) Where travel might involve low-angle travel or patient evacuation on slopes where rope can be used for safety but not for suspension

13.3.2.2 Outside of the specific environments identified above and/or by the AHJ, personnel from technician-level cave search and rescue organizations or special cave search and rescue resources shall be utilized when operating in a cave environment.

13.3.3 Organizations operating at the operations level at cave search and rescue incidents shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at incidents where cave search and rescue will be performed
(2)* Requesting and interfacing with cave search and rescue resources
(3)* Recognizing the types of cave passages and the vertical and horizontal extent of those passages as well as restrictions and water hazards involved in cave search and rescue incidents
(4)* Providing the specialized medical care and protocols that are unique to the cave environment
(5) Recognizing the need for, and procedures and equipment for the provision of, environmental protection through clothing systems applicable to the specific cave environments in which the organization could become involved
(6)* Selecting, caring for, and using personal, medical, and support equipment and packing it with due regard to how it will be carried and for protection from the cave environment

(7)* Traveling expeditiously through various cave environments in which the organization could become involved, while minimizing threats to safety
(8) Using appropriate cave navigation techniques, including map and compass, trail markers, balls of string, as well as any methods of navigation and position reporting
(9) Ensuring that personnel are capable of safely and effectively operating for an 8-hour period without support
(10) Procuring the necessary cave maps and navigational and topographical information
(11) Modifying actions and urgency as applicable to a rescue versus a recovery
(12) Acquiring information on current and forecast weather, including temperature, precipitation, and winds
(13)* Mitigating dangers from weather outside the cave on the rescue operation within the cave
(14)* Participating in and supporting cave search operations intended to locate victims whose exact location is unknown
(15) Accessing, packaging, and evacuating individuals from all cave environments and terrain where operations-level capabilities are appropriate
(16) Recognizing, identifying, and utilizing all rescue hardware and software used by the responding organizations with which the organization could become involved
(17)* Recognizing the team's limitations regarding accessing and/or evacuating a victim
(18) Establishing procedures for conducting an interview of a reporting party and for documenting and transmitting pertinent information
(19) Establishing procedures for recognizing and preserving evidence and a point last seen (PLS) or a last known point (LKP)
(20) Locating a subject in the operational environment based on reporting party information when the general location of the subject is known
(21)* Deploying and operating in-cave wired and wireless communications systems that allow direct communication from in-cave rescue operations personnel to incident command
(22) Establishing an accountability system for all persons and equipment entering or leaving any and all of the cave's entrances
(23) Recognizing and understanding the unique characteristics of search segmentation using a two-dimensional map for a three-dimensional cave
(24) Understanding when the incident requires a technician-level response or when other specialized resources are required

13.3.4 Each member of the cave rescue organization at the operational level shall train to a minimum of Level 2 Cave Rescuer as defined by the National Cave Rescue Commission of the National Speleological Society or equivalent.

13.4 Technician Level.

13.4.1 Organizations operating at the technician level at cave search and rescue incidents shall meet the requirements specified in this chapter and the following sections:

(1) Section 5.4 (technician level for rope rescue)
(2) Section 16.2 (awareness level for surface water search and rescue)
(3) Section 10.3 (operations level for wilderness search and rescue)

13.4.2 Organizations operating at the technician level at cave search and rescue incidents shall be capable of operating in environments in which special cave search and rescue training and equipment are required or where the capabilities of operations-level equipment and training are exceeded. Technician-level response capability shall be required where any of the following are true:

(1) Where cave passage involves difficult scrambling or climbing
(2) Where water obstacles deeper than 2 ft (0.61 m) are present
(3) Where search and/or rescue involves technical cave passage that is difficult to negotiate without special skills or that might be exposed or dangerous
(4) Where cave passage is tight and might require squeezing through constricted spaces
(5) Where travel or transport might involve fragile cave environments
(6) Where the incident might span more than one operational period of 8 hours
(7) Where specialized route-finding skills are required, or the use of cave maps is required
(8) Where travel or patient evacuation requires negotiating steep to vertical slopes where rope is essential for security or suspension

13.4.3 Organizations operating at the technician level shall be capable of performing and supervising all aspects of cave search and rescue operations with which the organization could become involved.

13.4.4* The ability of the organization to respond at the technician level in one type of cave search and rescue operation shall not imply the ability to respond at the technician level in all types of cave search and rescue operations.

13.4.5 Organizations operating at the technician level at cave search and rescue incidents shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at incidents where cave search and rescue will be performed
(2) Acquiring, utilizing, and coordinating search and rescue resources with which the organization could become involved
(3) Providing input to standard operating procedures for anticipated cave responses
(4)* Initiating and performing all aspects of search and rescue operations in the cave
(5)* Writing and utilizing an operational plan for cave search and rescue

13.4.6 Each member of the cave rescue organization at the technical level shall train to a minimum of Level 3 Cave Rescuer as defined by the National Cave Rescue Commission of the National Speleological Society or equivalent.

Chapter 14 Mine and Tunnel Search and Rescue

14.1 General Requirements.

14.1.1 Organizations operating at mine and tunnel incidents shall meet the requirements specified in Chapter 4.

14.1.2* The requirements of this chapter shall apply to agencies that provide varying degrees of response to tunnels under

construction or other underground excavations previously classified as mines or tunnels.

14.1.2.1 The requirements of this chapter shall not apply to operating mines, tourist mines, basements, or subterranean structures that are complete and in use (active).

14.1.2.2* The requirements of 7, Confined Space Search and Rescue, shall not apply to the basic underground structures and excavations addressed in this chapter but shall be relevant to equipment or spaces found inside the structure or excavation.

14.1.3* All mine and tunnel rescue services shall meet the requirements in 14.1.3.1 through 14.1.4.

14.1.3.1 Each member of the search and rescue organization shall be provided with, and be trained to properly use, the personal protective and rescue equipment necessary for making rescues from mines and tunnels according to his or her assignment and designated level of competency.

14.1.3.2* Each member of the search and rescue organization shall be equipped, trained, and capable of performing the assigned search and rescue duties corresponding to the member's assignment and designated level of competency.

14.1.3.3 Emergency services that are the designated primary provider of rescue services for operational mines and tunnels under construction shall comply with applicable regulations.

14.1.3.4* As part of a search and rescue organization, each member shall practice making mine or tunnel rescues, in accordance with the requirements of 4.1.10 (General Requirements, Training) of this document, by means of simulated rescue operations in which the member removes dummies, mannequins, or persons from actual mines and tunnels or from representative mines and tunnels.

14.1.3.5* The search and rescue organization shall be capable of responding in a timely manner to rescue summons.

14.1.3.6 Each member of the search and rescue organization shall be aware of the hazards he or she could confront when called on to perform rescue within mines or tunnels for which the organization is responsible.

14.1.3.7 The search and rescue organization shall have access to all identified mines and tunnels from which it is required to provide search and rescue services, in order to develop search and rescue plans and practice search and rescue operations according to its designated level of competency.

14.1.4* A mine and tunnel search and rescue team shall be made up of a minimum of five individuals.

14.2 Awareness Level.

14.2.1 Organizations operating at the awareness level for mine and tunnel search and rescue incidents shall meet the requirements specified in Sections 14.2, 7.2 (awareness level for confined space rescue), 11.2 (awareness level for trench and excavation rescue), and 5.2 (awareness level for rope rescue).

14.2.2 All members of the organization shall meet the requirements of Chapter 4 of NFPA 472 commensurate with the organization's needs.

14.2.3 Organizations operating at the awareness level for mine and tunnel search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for mine and tunnel search and rescue
(2) Initiating contact and establishing communications with victims where possible
(3)* Recognizing and identifying the hazards associated with nonentry mine and tunnel emergencies
(4)* Recognizing mines and tunnels
(5)* Implementing the emergency response system for mine and tunnel emergencies
(6)* Implementing site control and scene management

14.2.4 Individuals of the organization expected to perform functions at the awareness level shall meet the competencies prescribed at the awareness level in Chapter 14, Mine and Tunnel of Rescue of NFPA 1006.

14.3 Operations Level.

14.3.1 Organizations operating at the operations level for mine and tunnel search and rescue incidents shall meet the requirements specified in Sections 14.2 and 14.3, as well as in the following sections:

(1) Section 5.3 (operations level for rope rescue)
(2) Section 11.3 (operations level for trench and excavation search and rescue)
(3) Section 7.3 (operations level for confined space rescue)

14.3.2 The organization operating at this level shall be responsible for the development and training of a mine and tunnel rescue team of at least five individuals who are trained, equipped, and available to respond to mine and tunnel emergencies of a type and complexity that requires an operations-level organization.

14.3.3 Organizations operating at the operations level shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at mine and tunnel emergencies
(2) Protecting personnel from hazards within the mine and tunnel
(3)* Ensuring that personnel are capable of managing the physical and psychological challenges that affect rescuers entering mines and tunnels
(4)* Identifying the duties of the entry team, backup team, and search and rescue team leader
(5)* Monitoring continuously, or at frequent intervals, the atmosphere in all parts of the space to be entered for oxygen content, flammability (LEL/LFL), and toxicity, in that order
(6)* Providing an approved means of emergency egress respiratory protection with no less than a 30-minute-rated service life that is immediately available to each member of the organization entering a tunnel under construction or related excavation where no immediate atmospheric hazard has been identified
(7)* Performing entry-type rescues into mines and tunnels meeting all of the following specific qualifying characteristics:
    (a) Where the space has been previously surveyed by all team members who might need to enter the space as part of the rescue operation
    (b) Where a written pre-entry plan for the space is in place and is on site that clearly defines the conditions under which the team can enter that specific space

(c) Where a written rescue plan is in place and on site that specifically defines the types of incidents that might occur in the space and the expected actions of the rescue team for each incident
(d) Where all members who could be expected to enter the tunnel as part of the rescue plan will have physically practiced the elements of the rescue plan in the actual space or a representative space
(e) Where the known or suspected hazards for the specific incident are exclusive of any risks attributed to the tunnel environment itself such as fire, hazardous atmosphere, or potential collapse
(f) Where there are no known or anticipated conditions that would require deviation from the criteria established in the entry and pre-rescue plan
(g) Where conditions on the worksite or in the tunnel have not changed beyond the scope of those identified in the most recent entry and pre-rescue plan
(h) Where the internal configuration of the space is clear and unobstructed and rescue can be effected without possibility of entanglement
(i)* Where rescuers can pass easily through the access/egress opening(s) with room to spare when PPE is worn in the manner recommended by the manufacturer
(j)* Where the space can accommodate two or more rescuers in addition to the victim
(k)* Where a previously developed hazard control plan is in place and all identified hazards have been controlled in accordance with the plan
(l) Where specific criteria for suspending or terminating an entry or rescue operation are clearly identified to all members
(m) Where contingencies for emergencies during the entry or rescue operation are provided for, such as areas of refuge or intervention methods

(8)* Using victim packaging devices that could be employed in mine and tunnel rescue
(9) Transferring victim information, including location, surroundings, condition when found, present condition, and other pertinent information to emergency medical services personnel
(10) Planning and implementing a mine and tunnel rescue operation
(11)* Selecting, constructing, and using a rope-lowering and -raising system in the high-angle environment
(12) Controlling all identified entry points to the mine/tunnel to prevent unauthorized entry and accounting for all rescuers who might enter the space

14.3.4 Individuals in the organization expected to perform functions at the operations level shall meet the competencies prescribed at the operations level in Chapter 14, the Mine and Tunnel Rescue, of NFPA 1006.

14.4 Technician Level.

14.4.1 Organizations operating at the technician level for mine and tunnel search and rescue emergencies shall meet the requirements of this chapter and Sections 12.3 (operations level for machinery search and rescue), 7.4 (technician level for confined space search and rescue), 11.3 (operations level for trench and excavation search and rescue), and 5.3 (operations level for rope rescue).

14.4.2* The organization operating at this level shall be responsible for the development of a mine and tunnel rescue team of at least five individuals who are trained, equipped, and available to respond to mine and tunnel emergencies of a type and complexity that requires a technician-level organization.

14.4.2.1* A backup team with similar size and capabilities as the entry team shall be immediately available to intervene on behalf of the entry team.

14.4.2.2* The need for egress-only respiratory protection identified in 14.3.3(6) shall be considered satisfied for members of an entry team who have selected and donned atmosphere-supplying respirators identified by the AHJ for use in the mine or tunnel environment as part of an entry plan to enter a space with a recognized atmospheric hazard, provided the conditions of 14.4.2.5 and 14.4.2.6 have been met.

14.4.2.2.1 There shall be at least one respirator unit per member in the tunnel.

14.4.2.3 Each entry team shall, as a minimum, have the ability to continuously monitor the air for oxygen, carbon monoxide, hydrogen sulfide, and combustible gases as well as any other atmospheric contaminants that are known or suspected.

14.4.2.4* The entry team shall have at least one method of verbal communication with the surface.

14.4.2.4.1* All team members shall be aware of prescribed action levels for specific contaminants or atmospheric conditions.

14.4.2.5 Entry teams that enter a mine or tunnel with a known atmospheric hazard shall have a clearly defined "turnaround" benchmark to ensure adequate egress to an area of refuge or safety.

14.4.2.6* Each entry team that enters a mine or tunnel with a known atmospheric hazard shall have at least one source of breathable air per team, independent of each wearer's SCBA, to be used in the event of an SCBA failure or "out of air" emergency, that is adequate to ensure egress of the wearer and that is independent of any device brought in for the use of the victim.

14.4.3 Organizations operating at the technician level for mine and tunnel search and rescue emergencies shall develop and implement procedures for the following:

(1) Performing entry and rescue operations into tunnels for which a pre-entry or pre-rescue plan has not been developed or spaces where those plans are not consistent with conditions at the site
(2) Performing entry and rescue operations in tunnels or spaces where the hazards present could include those that are inherent to the environment such as fire, collapse, and atmospheric hazards
(3) Providing all members who are designated as part of the technician-level team with training in accordance with technician-level II rescuer for mine and tunnel rescue described in NFPA 1006
(4) Providing members of the entry team access to specialized tools and training required to lift loads, move patients, cut steel, break concrete, or other tasks identified as associated with performing rescue operations in a mine or tunnel
(5) Providing members of the entry team with access to and training in respiratory protection such as CCBA or SCBA

commensurate with the size and configuration of the spaces and travel distances associated with mines and tunnels
(6)* Evaluating existing and potential conditions at mine and rescue emergencies
(7)* Ensuring that rescue team members take part in a medical surveillance program
(8)* Planning response for entry-type mine and tunnel rescues in hazardous environments
(9)* Implementing the planned response

Chapter 15 Helicopter Search and Rescue

15.1 General Requirements.

15.1.1 Organizations operating at helicopter search and rescue incidents shall meet the requirements specified in Chapter 4.

15.1.2* The AHJ shall evaluate the need for helicopter search and rescue within its response area and shall provide a search and rescue capability commensurate with the identified needs.

15.2 Awareness Level.

15.2.1 Organizations operating at the awareness level for helicopter search and rescue shall meet the requirements specified in Section 15.2.

15.2.2 Organizations operating at the awareness level for helicopter search and rescue shall develop and implement procedures for the following:

(1) Recognizing the need for helicopter search and rescue
(2) Identifying the resources necessary to conduct helicopter search and rescue
(3) Identifying a landing zone or helispot in accordance with the AHJ
(4) Sizing up potential conditions where helicopter search and rescue will be performed
(5) Initiating the emergency response system for helicopter search and rescue
(6) Initiating site control and scene management
(7) Ensuring safety in and around landing zones and helicopters in support of helicopter search and rescue
(8)* Recognizing general hazards associated with helicopters and procedures necessary to mitigate these hazards within the operational area
(9)* Identifying PPE required by awareness-level personnel assigned to work in the vicinity of helicopters
(10) Identifying the general uses of helicopters with which the organization could become involved
(11) Establishing communications with the helicopter crew or their agency according to procedures established by the AHJ
(12)* Prior to flying as a passenger on a search and rescue helicopter, ensuring that a preflight safety briefing has been received from the pilot or his designate
(13) Communicating outside the helicopter in accordance with the AHJ

15.3 Operations Level.

15.3.1 Organizations operating at the operations level for helicopter search and rescue incidents shall meet the requirements specified in Section 15.2 (helicopter search and rescue awareness).

15.3.2 Organizations operating at the operations level for helicopter search and rescue incidents shall develop and implement procedures commensurate with the identified needs of the organization for the following:

(1) Ensuring safety in and around the helicopter
(2)* Identifying the minimum required crew complement and functions needed for helicopter search and rescue operations
(3) Identifying and selecting the kind and type of helicopter required to perform a specific mission
(4) Maintaining proficiency in procedures involved with in-flight emergencies
(5)* Maintaining proficiency in post-crash egress and survival training appropriate to the environment likely to be encountered
(6) Communicating inside the helicopter in accordance with the AHJ
(7) Performing search observation techniques in accordance with the AHJ
(8) Managing a landing zone or helispot in accordance with the AHJ
(9) Developing an alternate helicopter operational plan in case the primary plan cannot be accomplished

15.4 Technician Level.

15.4.1 Organizations operating at the technician level for helicopter search and rescue shall meet the requirements specified in this chapter and Section 5.3 (rope operations).

15.4.2 Organizations operating at the technician level for helicopter search and rescue shall develop and implement procedures for the following:

(1) Evaluating existing and potential conditions at incidents where helicopter search and rescue operations will be performed
(2) Facilitating operational communications
(3) Performing helicopter search operations, including the provision of trained search observer(s) in a helicopter in accordance with the needs of the AHJ
(4) Performing helicopter rescue operations in accordance with the needs of the AHJ
(5) Identifying, selecting, and utilizing PPE in any environment in which the organization might become involved
(6)* Applying an understanding of the effects of flight on the human body
(7)* Identifying and managing a temporary landing zone or a helispot
(8) Recognizing the factors affecting weight and balance calculations on the aircraft used by the search and rescue organization.
(9) Performing emergency procedures in the aircraft used by the organization
(10) Selecting, constructing, and utilizing both single-point and multiple-point load-sharing anchor systems, both inside and outside the helicopter(s) used by the organization
(11) Reporting information that has the potential to affect helicopter operations or safety
(12) Inspecting and using search and rescue equipment in, on, or attached to the helicopter used by the organization

Chapter 16 Surface Water Search and Rescue

16.1 General Requirements. Organizations operating at surface water search and rescue incidents shall meet the requirements specified in Chapter 4.

16.2 Awareness Level.

16.2.1 Organizations operating at the awareness level at surface water search and rescue incidents shall meet the requirements specified in Section 16.2.

16.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

16.2.3 Organizations operating at the awareness level at surface water search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for surface water search and rescue
(2)* Implementing the assessment phase
(3)* Identifying the resources necessary to conduct safe and effective water operations
(4)* Implementing the emergency response system for surface water rescue incidents
(5)* Implementing site control and scene management
(6)* Recognizing general hazards associated with surface water search and rescue incidents and the procedures necessary to mitigate these hazards within the general search and rescue area
(7)* Determining rescue versus recovery

16.3 Operations Level.

16.3.1 Organizations operating at the operations level at surface water search and rescue incidents shall meet the requirements specified in Section 16.2 and in 16.3.1 through 16.3.7.

16.3.2 Any member of the organization who could be expected to perform at the operations level for surface water search and rescue shall be provided training to meet the job performance requirements for operations-level surface water rescue as defined in NFPA 1006.

16.3.3* Any member of the organization who could be expected to perform functions as a crewmember on a watercraft shall be provided training to meet the job performance requirements for operations-level watercraft operations as defined in NFPA 1006 for the types of watercraft used by the agency under conditions representative of those typically encountered in the work environment.

16.3.4* Any member of the organization who could be expected to perform functions as the operator of a watercraft shall be provided training to meet the job performance requirements for technician-level watercraft operations as defined in NFPA 1006 for the types of watercraft used by the agency under conditions representative of those typically encountered in the work environment.

16.3.5 Organizations operating at the operations level at surface water search and rescue incidents shall develop and implement procedures for performing a risk benefit analysis that shall include the following:

(1)* A survival profile of the potential victim
(2)* A risk profile for the proposed rescue operation

16.3.6* Personnel operating in the hazard zone who are not expected to enter the water as part of the rescue plan shall be provided the following minimum PPE:

(1)* PFD or other PPE approved by the AHJ as designed to provide inherent or on-demand positive buoyancy to the user for the expected tasks and conditions encountered in the specific rescue environment
(2) Whistle or other audible signaling device
(3)* Visible signaling device

16.3.7 Organizations operating at the operations level at surface water search and rescue incidents shall develop and implement procedures for performing nonentry rescue, including the following:

(1)* Initial and ongoing size-up of existing and potential conditions at incidents where surface water search and rescue training and operations will be performed
(2)* Ensuring personal safety at water operations
(3)* Assessing water conditions in terms of hazards to the victim and the rescuer
(4) Separating, isolating, securing, and interviewing witnesses
(5) Evaluating or assessing the potential rescue problems
(6)* Evaluating the progress of the planned response to ensure the objectives are being met
(7)* Conducting shore-based rescue operations
(8)* Using throw bags and related retrieval tools
(9)* Providing assistance to organizations operating at the technician level
(10)* Intervention and self-rescue methods for rescuers who accidentally become immersed
(11)* Identifying and managing heat and cold stress to the rescuer
(12) Using packaging devices identified by the AHJ to be employed for removal of water-bound patients
(13) Transferring victim information, including location, surroundings, condition when found, present condition, and other pertinent information, to emergency medical services personnel
(14)* Using watercraft-assisted and watercraft-based operations if watercraft are used by the organization
(15) Planning to meet operational objectives
(16)* Performing rapid extrication of accessible victims
(17) Performing search operations for missing subjects, which do not require the rescuer to enter the water but that identify areas of highest probability and track progress of the search
(18)* Managing incidents that involve waterbound vehicles, vessels, structures, or other circumstances that pose additional challenges to the rescue operation
(19) Providing a method for accounting for the location of all responders at the scene and ensuring their welfare

16.4 Technician Level.

16.4.1 Organizations operating at the technician level for surface water search and rescue shall meet the requirements in Sections 16.2, 16.3, and 16.4.

16.4.2 Any member of the organization who could be expected to perform at the technician level for surface water search and rescue shall be provided training to meet the job performance requirements for technician-level surface water rescue as defined in NFPA 1006.

16.4.3 Organizations operating at the technician level at surface water search and rescue incidents shall develop and implement the following procedures, which allow for deploying a rescuer or rescuer(s) into the water to conduct a search and rescue task:

(1) Performing a risk benefit analysis based on the victim's projected survival profile and the potential risks the operation poses to the responder
(2) Using a checklist or other method to ensure all required elements of the rescue plan are in place prior to deploying a rescuer into the water
(3)* Providing an intervention plan with specific methods for rescue or removal of rescuers who become injured or fatigued while in the water
(4)* Conducting a search for a missing victim(s) or victims so that the areas of highest probability are identified and progress of the search can be monitored and documented
(5) Methods for managing incidents that involve waterbound vehicles and vessels or other circumstances that pose multiple concurrent challenges to the rescue operation
(6) Providing a method to maintain communication or contact with a rescuer(s) in the water so that the rescuer's location is known and assistance can be summoned immediately

Chapter 17 Swiftwater Search and Rescue

17.1 General Requirements. Organizations operating at swiftwater search and rescue incidents shall meet the requirements specified in Chapter 4.

17.2 Awareness Level.

17.2.1 Organizations operating at the awareness level at swiftwater search and rescue incidents shall meet the requirements specified in Section 17.2.

17.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

17.2.3 Organizations operating at the awareness level at swiftwater search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for swiftwater search and rescue
(2)* Implementing the assessment phase
(3)* Identifying the resources necessary to conduct swiftwater search and rescue operations
(4)* Implementing the emergency response system for swiftwater search and rescue incidents
(5)* Implementing site control and scene management
(6)* Recognizing general hazards associated with swiftwater search and rescue incidents and the procedures necessary to mitigate these hazards within the general search and rescue area
(7) Determining rescue versus recovery

17.3 Operations Level.

17.3.1 Organizations operating at the operations level at swiftwater search and rescue incidents shall meet the requirements specified in Section 16.3 and 17.3.1 through 17.3.4.

17.3.2 Any member of the organization who could be expected to perform at the operations level for swiftwater search and rescue shall be provided training to meet the job performance requirements for operations-level swiftwater rescue as defined in NFPA 1006.

17.3.3 Organizations operating at the operations level for swiftwater rescue shall be capable of applying the requirements of Section 8.3 under conditions representative of the swiftwater environment.

17.3.4 For personnel operating in the hazard zone at a swiftwater search and rescue incident, the minimum PPE provided shall include the following:

(1) Personal flotation device (PFD) intended for use in the swiftwater environment
(2) Thermal protection
(3)* Helmet appropriate for swiftwater rescue
(4) Cutting device that is easily accessible and that will at a minimum cut the ropes and webbing used by the AHJ
(5) Whistle or audible signaling device

17.4 Technician Level.

17.4.1 Organizations operating at the technician level for swiftwater search and rescue shall meet the requirements in Section 8.4, Section 17.3, and 17.4.1 through 17.4.5.

17.4.2 Organizations operating at the technician level for swiftwater search and rescue shall apply the requirements of Section 8.4 under conditions representative of the swiftwater environment.

17.4.3 Any member of the organization who could be expected to perform at the technician level for swiftwater search and rescue shall be provided training to meet the job performance requirements for technician-level swiftwater rescue as defined in NFPA 1006.

17.4.4 Organizations operating at the technician level at swiftwater search and rescue incidents shall develop and implement procedures for applying rope rescue techniques in the swiftwater environment.

17.4.5 Organizations operating at the technician level at swiftwater search and rescue incidents shall have the following capabilities:

(1) Constructing and operating rope rescue system anchors and mechanical advantage systems as specified by the AHJ
(2) Constructing a tension diagonal rope system
(3) Constructing a highline system over water
(4) Constructing and operating rope systems that position and move a tethered boat controlled by ropes

17.4.6 Organizations operating human-powered watercraft in a swiftwater search and rescue environment shall develop and implement procedures for the use of human-powered watercraft in the swiftwater search and rescue environment.

17.4.7 Organizations operating motorized watercraft in a swiftwater search and rescue environment shall develop and implement procedures for the use of motorized watercraft in the swiftwater search and rescue environment.

Chapter 18 Dive Search and Rescue

18.1 General Requirements. Organizations operating at dive search and rescue incidents shall meet the requirements specified in Chapter 4.

18.2 Awareness Level.

18.2.1 Organizations operating at the awareness level at dive search and rescue incidents shall meet the requirements specified in Section 18.2.

18.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

18.2.3 Organizations operating at the awareness level at dive search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for dive search and rescue
(2)* Implementing the assessment phase
(3)* Identifying the resources necessary to conduct dive rescue operations
(4)* Implementing the emergency response system for dive rescue incidents
(5)* Implementing site control and scene management
(6)* Recognizing general hazards associated with dive search and rescue incidents and the procedures necessary to mitigate these hazards within the general search and rescue area
(7)* Determining rescue versus recovery

18.3 Operations Level.

18.3.1 Organizations operating at the operations level at dive search and rescue incidents shall meet the requirements specified in Section 8.3, Section 18.2, and 18.3.1 through 18.3.5.

18.3.2 Any member of the organization who could be expected to perform at the operations level for dive search and rescue shall be provided training to meet the job performance requirements for operations-level dive rescue as defined in NFPA 1006.

18.3.3 Organizations operating at the operations level for dive rescue shall be capable of applying the requirements of Section 8.3 under conditions representative of the dive rescue environment.

18.3.4 For personnel operating in the hazard zone at a dive rescue incident, the minimum PPE provided shall include the following:

(1)* Personal flotation device (PFD) or other PPE approved by the AHJ as designed to provide inherent or on-demand positive buoyancy to the user for the expected tasks and conditions encountered in the specific rescue environment
(2) Thermal protection
(3) Whistle or audible signaling device
(4) Cutting tool

18.3.5 Organizations operating at the operations level for dive rescue shall develop and implement procedures for fulfilling the function of a dive tender at a dive rescue incident, including the following:

(1)* Recognizing the unique hazards associated with dive operations
(2)* Serving as surface support personnel, including obtaining and assembling the diver's gear, assisting with donning, and performing all pre-entry checks
(3) Identifying water characteristics
(4)* Operating surface support equipment used in water operations
(5) Procuring the necessary equipment to perform dive operations
(6) Employing techniques for water access, entry, and egress for divers
(7)* Participating in dive operations at any time of day or in any climate the organization encounters
(8) Recognizing conditions or situations where a diver might need assistance
(9) Implementing standardized contingency procedures for dive-related emergencies, including a diver in distress, a missing or injured diver, and related medical emergencies
(10) Providing the necessary medical equipment at the designated egress point to manage medical emergencies commonly associated with compressed gas diving
(11) Tracking and documenting status of divers, including bottom time, location, repetitive dive status, and, when possible, depth
(12) Using standardized methods to communicate with divers while they are on the surface and while submerged
(13) Tracking and documenting the progress of subsurface search operations

18.4 Technician Level.

18.4.1 Organizations operating at the technician level for dive search and rescue shall meet the requirements in Section 8.3 and 18.4.1 through 18.4.11.

18.4.2 Organizations operating at the technician level for dive rescue shall apply the requirements of Section 16.4 (technician-level surface water rescue) in a manner consistent with the anticipated conditions of the rescue environment.

18.4.3 Any member of the organization who is recognized as a diver shall be provided training to meet all the job performance requirements for technician-level dive rescue as defined in NFPA 1006.

18.4.4* The AHJ shall ensure that all members of the organization who are recognized as divers obtain and maintain current dive certification from an agency or organization recognized as providing a curriculum focused on public safety diving.

18.4.5* For all diving members of a technician-level organization, an annual fitness test and a watermanship/skills test and basic scuba skills evaluation supplied by the International Association of Dive Rescue Specialists (IADRS) shall be conducted to maintain public safety diver capability.

18.4.6 Prior to engaging in subsurface operations, any organization operating at the technician level at dive rescue incidents shall make provisions for the following functions whenever divers are in the water, and these functions shall be exclusive of other duties such as supervision, surface support, and standby resources:

(1)* Designating an on-site dive supervisor who has the authority to manage all aspects of the dive operation and has been trained to meet all nondiving job performance requirements of technician-level dive rescue as defined in NFPA 1006
(2) Designating a dive tender who is responsible for assisting divers with assembly and donning of equipment, communicating with divers, tracking their location, and managing subsurface search operations and who has been

trained to meet all the job performance requirements of operations-level dive rescue as defined in NFPA 1006

(3)* Designating a safety diver who is equipped and positioned to immediately submerge and lend assistance to a diver in distress or to engage in a search for a missing diver

(4)* Designating a 90 percent diver who is equipped and positioned to quickly enter the water and assume the role of safety diver if necessary

18.4.7 The agency shall ensure that the following equipment is present at the dive site and readily available prior to engaging in subsurface activities:

(1) Medical oxygen and related delivery equipment
(2) Backboard or other device suitable for the movement of a nonambulatory diver
(3) Means of summoning aid without leaving the dive site
(4) A dive flag or float in areas subject to vessel traffic readily visible to vessels approaching the dive location
(5) Copy of the agency's dive emergency response plan
(6) Audible signaling device
(7) Means of immediately recording required information relating to each diver's status and dive profile in a manner that is readily communicated or transferred to other members of the team or medical professionals

18.4.8 Organizations operating at the technician level at dive incidents shall develop and implement procedures for performing public safety scuba diving, including the following:

(1)* Managing a diver's breathing gas supply and bottom time so that on reaching the surface the diver has a minimum reserve pressure that reflects one third of the entire rated capacity of the total primary breathing gas available to the diver and in no case allowing the established minimum reserve pressure for the primary source of breathing gas to be less than 500 psi.
(2) Applying an understanding of physics and physiology as they relate to the diver, diver-related emergencies, and the underwater environment
(3)* Applying dive tables or other methods designated by the AHJ that use a diver's bottom time and depth to determine his/her level of hyperbaric exposure, including the use of letter group designators, any potential decompression obligation, and the ability to perform repetitive dives
(4) Identifying and evaluating underwater environments and conditions to which the public safety diver could be exposed
(5) Identifying and managing the hazards posed by underwater plants and animals
(6) Conducting and supervising dive operations, including planning a dive based on projected depths, bottom times, and available air supply for a particular mission
(7)* Identifying, selecting, and implementing standardized techniques to perform and track the progress of a search that is consistent with the mission of the agency and anticipated conditions that might be encountered in their response area
(8)* Using recognized tools, such as a field neurological exam, to identify divers who are experiencing dive-related maladies, including psychological and physiological stress, air embolism, and decompression sickness
(9) Recognizing and managing the impact of near-drowning in cold water
(10)* Identifying, selecting, and implementing standardized methods of communicating between a submerged diver and the surface so that the diver can immediately summon help, be recalled to the surface, directed in a search pattern, and warned of imminent hazards
(11)* Utilizing redundant and alternative air sources and techniques during low-air or out-of-air emergencies
(12)* Using full-body encapsulation equipment, including dry suits, dry hoods, and dry gloves, with a full-face mask as required by the AHJ, to protect divers from cold or potentially contaminated water
(13)* Rescuing an entangled diver
(14)* Performing pre- and post-entry medical monitoring of divers
(15)* Recovering evidence, including locating, securing, and packaging evidence, documenting and maintaining the chain of custody, and documenting the scene
(16)* Implementing standardized contingency procedures from the agency's dive emergency response plan for rescue operations in the event of primary diver injury, entrapment, loss of communication, and/or disconnect
(17) Using positive connection systems such as chest harnesses and tending lines with quick-release connectors when the use of such systems does not compromise the safety of the diver
(18)* Using standardized written checklists to verify the condition, proper configuration, and operation of a diver's equipment before he/she enters the water

18.4.9* All diving members of the organization shall have a medical exam conducted by a physician with specific training in hyperbaric exposure and dive-related injuries before engaging in dive operations and annually thereafter.

18.4.10 Organizations operating human-powered watercraft in a dive rescue environment shall develop and implement procedures for the use of human-powered watercraft in the dive rescue environment.

18.4.11 Organizations operating motorized watercraft in a dive rescue environment shall develop and implement procedures for the use of motorized watercraft in the dive rescue environment.

18.4.12* The AHJ shall ensure that all diving members of the organization complete a subsurface task utilizing tools and tactics identified by the AHJ as consistent with the mission of the team under conditions representative of the rescue environment no less than 4 times over 12 months.

Chapter 19 Ice Search and Rescue

19.1 General Requirements. Organizations operating at ice search and rescue incidents shall meet the requirements specified in Chapter 4.

19.2 Awareness Level.

19.2.1 Organizations operating at the awareness level at ice search and rescue incidents shall meet the requirements specified in Section 19.2.

19.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

19.2.3 Organizations operating at the awareness level at ice search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for ice search and rescue
(2)* Implementing the assessment phase
(3)* Identifying the resources necessary to conduct ice rescue operations
(4)* Implementing the emergency response system for ice rescue incidents
(5)* Implementing site control and scene management
(6)* Recognizing general hazards associated with ice search and rescue incidents and the procedures necessary to mitigate these hazards within the general search and rescue area
(7) Determining rescue versus recovery

19.3 Operations Level.

19.3.1 Organizations operating at the operations level at ice search and rescue incidents shall meet the requirements specified in Section 8.3 and 19.3.1 through 19.3.4.

19.3.2 Any member of the organization who could be expected to perform at the operations level for ice search and rescue shall be provided training to meet the job performance requirements for operations-level ice rescue as defined in NFPA 1006.

19.3.3 Organizations operating at the operations level for ice search and rescue shall be capable of applying the requirements of Section 8.3 under conditions representative of the ice rescue environment.

19.3.4 For personnel operating in the hazard zone at an ice search and rescue incident, the minimum PPE provided shall include the following:

(1) Personal flotation device (PFD) or other PPE designed with inherent buoyancy intended for use in the ice rescue environment
(2) Thermal protection
(3) Whistle or audible signaling device
(4) Ice awls/picks

19.3.5 Organizations operating at the operations level for ice search and rescue incidents shall develop and implement procedures for evaluating ice strength and conditions.

19.4 Technician Level.

19.4.1 Organizations operating at the technician level for ice search and rescue incidents shall meet the requirements in Section 8.4, Section 19.3, and 19.4.1 through 19.4.6.

19.4.2 Organizations operating at the technician level for ice search and rescue shall apply the requirements of Section 8.4 under conditions representative of the ice rescue environment.

19.4.3 Any member of the organization who could be expected to perform at the technician level for ice search and rescue shall be provided training to meet the job performance requirements for technician-level ice rescue as defined in NFPA 1006.

19.4.4 Organizations operating at the technician level at ice search and rescue incidents shall develop and implement procedures for applying specialized tools and rescue techniques for the ice rescue environment.

19.4.5 Organizations operating human-powered watercraft in an ice search and rescue environment shall develop and implement procedures for the use of human-powered watercraft in the ice search and rescue environment.

19.4.6 Organizations operating motorized watercraft in an ice search and rescue environment shall develop and implement procedures for the use of motorized watercraft in the ice search and rescue environment.

Chapter 20 Surf Search and Rescue

20.1 General Requirements.

20.2 Awareness Level. Organizations operating at surf search and rescue incidents shall meet the requirements specified in Chapter 4.

20.2.1 Organizations operating at the awareness level at surf search and rescue incidents shall meet the requirements specified in Section 20.2.

20.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

20.2.3 Organizations operating at the awareness level at surf search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for surf search and rescue and conducting nonentry victim location and observation techniques
(2)* Conducting a dynamic size-up and hazard/risk assessment
(3)* Identifying the resources necessary to conduct surf search and rescue operations based on conditions observed
(4)* Implementing the emergency response system for surf search and rescue incidents
(5)* Implementing site control and scene management, including a personnel accountability system
(6)* Recognizing general hazards associated with surf search and rescue incidents and the procedures necessary to mitigate these hazards within the general search and rescue area
(7)* Determining rescue versus recovery

20.3 Operations Level.

20.3.1 Organizations operating at the operations level at surf search and rescue incidents shall meet the requirements specified in Section 8.3 and 20.3.1 through 20.3.4.

20.3.2 Any member of the organization who could be expected to perform at the operations level for surf search and rescue shall be provided training to meet the job performance requirements for operations-level surf rescue as defined in NFPA 1006.

20.3.3 Organizations operating at the operations level for surf search and rescue shall be capable of applying the requirements of Section 8.3 under conditions representative of the surf search and rescue environment.

20.3.4 For personnel operating in the hazard zone at a surf search and rescue incident, the minimum PPE provided shall include a personal flotation device (PFD) or other PPE designed with inherent buoyancy intended for use in the surf search and rescue environment.

20.3.5 Organizations operating at the operations level for surf search and rescue shall develop and implement procedures for evaluating surf size, strength, and conditions.

20.4 Technician Level.

20.4.1 Organizations operating at the technician level for surf search and rescue shall meet the requirements in Section 8.4, Section 20.3, and 20.4.1 through 20.4.6.

20.4.2 Organizations operating at the technician level for surf search and rescue shall apply the requirements of Section 8.4 under conditions representative of the surf search and rescue environment.

20.4.3 Any member of the organization who could be expected to perform at the technician level for surf search and rescue shall be provided training to meet the job performance requirements for technician-level surf rescue as defined in NFPA 1006.

20.4.4 Organizations operating at the technician level at surf search and rescue incidents shall develop and implement procedures for applying specialized tools and rescue techniques for the surf search and rescue environment.

20.4.5 Organizations operating human-powered watercraft in a surf search and rescue environment shall develop and implement procedures for the use of human-powered watercraft in the surf search and rescue environment.

20.4.6 Organizations operating motorized watercraft in a surf search and rescue environment shall develop and implement procedures for the use of motorized watercraft in the surf search and rescue environment.

Chapter 21 Watercraft Search and Rescue

21.1 General Requirements.

21.1.1 Organizations operating watercraft at search and rescue incidents shall meet the requirements specified in Chapter 4.

21.1.2* This chapter outlines the requirements for use of both human-powered and motorized watercraft to perform search and rescue operations.

21.1.3* The AHJ shall ensure that the requirements of this section are met in a manner consistent with the water and weather conditions typically associated with the agency's projected mission.

21.1.4 No part of this section shall be used to abridge or circumvent certifications or licenses legally required to operate specific watercraft in a particular region, city, or state.

21.2 Awareness Level.

21.2.1 Organizations operating at the awareness level at watercraft search and rescue incidents shall meet the requirements specified in Section 21.2.

21.2.2 Each member of an organization operating at the awareness level shall be a competent person as defined in 3.3.21.

21.2.3 Organizations operating at the awareness level at watercraft search and rescue incidents shall implement procedures for the following:

(1) Recognizing the need for watercraft in a search and rescue operation
(2) Implementing the assessment phase
(3) Identifying the resources necessary to conduct watercraft search and rescue operations, including launching and recovery sites
(4) Implementing the emergency response system for mobilizing search and rescue watercraft
(5) Implementing site control and scene management
(6) Recognizing general hazards associated with watercraft search and rescue operations and the procedures necessary to mitigate these hazards within the general search and rescue area
(7) Determining rescue versus recovery, if possible

21.3 Operations Level.

21.3.1 Organizations operating at the operations level at watercraft search and rescue incidents shall meet the requirements specified in Section 21.2 and 21.3.1 through 21.3.5.

21.3.2 Any member of the organization who could be expected to perform at the operations level for watercraft search and rescue incidents shall be provided training to meet the job performance requirements for operations-level surface water rescue as defined in NFPA 1006.

21.3.3* Any member of the organization who could be expected to perform functions as a crewmember on a watercraft shall be provided training to meet the job performance requirements for operations-level watercraft operations as defined in NFPA 1006 for the types of watercraft used by the agency under conditions representative of those typically encountered in the work environment.

21.3.4* Personnel operating in or on watercraft who might be exposed to accidental immersion shall wear the following minimum PPE:

(1) Personal flotation device (PFD)
(2) Whistle or other audible signaling device
(3)* Visible signaling device

21.3.5* Organizations operating at the operations level at watercraft search and rescue incidents shall develop and implement procedures for using watercraft in search and rescue operations, including the following:

(1) Identifying the types of watercraft available to the agency and their capabilities, limitations, and any special considerations associated with each type of craft
(2) Identifying the roles of crewmembers for each type of watercraft available to the agency
(3) Providing for the safety of each crewmember and passenger on the watercraft, including methods for accountability and briefing passengers on emergency procedures
(4) Performing an ongoing size-up of existing and potential conditions where watercraft search and rescue operations and training will be performed
(5) Assessing water conditions in terms of hazards to the victim and the rescuer and the capability of the watercraft
(6)* Communicating with other agencies or resources that might be part of a watercraft-based search and rescue operation
(7)* Conducting operations to take a vessel under tow with motorized watercraft, if used by the AHJ
(8)* Conducting watercraft-based operations for deploying and recovering rescuers from the water

(9)* Conducting watercraft-based operations for rescuing and recovering both unconscious and conscious waterbound subjects
(10) Deploying and recovering any watercraft used by the organization
(11)* Deploying crew overboard (COB) measures, including a U.S. Coast Guard–approved Type IV throwable PFD, water rescue throw bags, heaving lines, or similar devices, for passengers or crew who fall overboard
(12) Performing watercraft-based search operations that identify areas of highest probability and areas previously searched
(13) Managing incidents that involve operating around waterbound vehicles, other vessels, submerged hazards, or other circumstances that pose additional challenges to the rescue operation
(14) Identifying navigational aids, such as lights, symbols, or sounds that are used to identify other watercraft, navigational channels, waterway features, or hazards
(15) Identifying and utilizing audible and visual distress signals
(16) Identifying emergency conditions on the watercraft, such as fire or flooding, and implementing required actions

21.4 Technician Level.

21.4.1 Organizations operating at the technician level at watercraft search and rescue incidents shall meet the requirements specified in Section 21.3 and 21.4.1 through 21.4.3.

21.4.2* Any member of the organization who might be expected to perform functions as the operator of a watercraft shall be provided training to meet the job performance requirements for technician-level watercraft operations as defined in NFPA 1006 for the types of watercraft used by the agency under conditions representative of those typically encountered in the work environment.

21.4.3* Organizations operating at the technician level at watercraft search and rescue incidents shall develop and implement procedures for operating watercraft in search and rescue operations, including the following:

(1)* Operating a motorized watercraft with a vessel under tow, if used by the AHJ
(2)* Operating a watercraft while deploying and recovering rescuers to and from the water
(3)* Operating a watercraft for recovering both unconscious and conscious waterbound subjects
(4) Using watercraft-specific navigational systems, tools, and techniques so that the position of the craft can be accurately determined and a desired destination reached
(5)* Operating a vessel or watercraft in response to a crew overboard (COB) event, which includes a U.S. Coast Guard–approved Type IV throwable PFD, water rescue throw bags, heaving lines, or similar devices
(6) Operating and navigating watercraft in a search operation that identifies areas of highest probability and documents areas previously searched
(7) Operating watercraft in environments that include waterbound vehicles, vessels, submerged objects, or other hazards that pose additional challenges to the rescue operation
(8) Incorporating the use of navigational aids, such as lights, symbols, or sounds, that are used to identify other watercraft, features, or hazards to reach the intended destination and avoid collisions and groundings

Chapter 22 Flood Search and Rescue

22.1 General Requirements. The AHJ operating at flood search and rescue incidents shall meet the requirements specified in Chapter 4 and Chapter 8.

22.1.1 The AHJ shall evaluate the need for a missing person search in flood incidents that might occur within its response area.

22.1.2 The AHJ shall provide a search capability commensurate with the identified needs.

22.2 Awareness Level.

22.2.1 Members of organizations at the awareness level shall be permitted to assist in support functions on a flood search and rescue operation but shall not be deployed into the floodwater-affected areas.

22.2.2 Organizations operating at the awareness level at any flood search and rescue incident shall have the following capabilities:

(1) Recognizing the need for a flood search and rescue–type response
(2)* Initiating the emergency response system for flood search and rescue
(3)* Initiating incident management systems suitable to the scale and nature of the flood
(4)* Recognizing the hazards associated with flood search and rescue incidents
(5)* Recognizing the types of floods and the impact to the organization
(6)* Recognizing the different phases of a flood and the impact to the organization
(7) Recognizing the limitations of emergency response skills and equipment in the flood environments
(8) Initiating the collection and recording of information necessary to assist operational personnel in a flood search and rescue incident
(9)* Understanding the social, economic, and political issues associated with flood incidents
(10)* Recognizing and implementing a search marking system suitable for the flood environment

22.3 Operations Level.

22.3.1 Organizations operating at the operations level at flood search and rescue incidents shall meet the requirements specified in Section 8.3 and 22.3.1 through 22.3.7.

22.3.2 Any member of the organization who could be expected to perform at the operations level for flood search and rescue shall be provided training to meet the job performance requirements for operations-level flood rescue as defined in NFPA 1006.

22.3.3 Organizations operating at the operations level for flood search and rescue shall be capable of applying the requirements of Section 8.3 under conditions representative of the flood environment.

22.3.4 For personnel operating in the hazard zone at a flood search and rescue, the minimum PPE provided shall include the following:

(1) Personal flotation device (PFD) intended for use in the flood environment
(2) Thermal protection
(3) Cutting device that is easily accessible and that will at a minimum cut the ropes and webbing used by the AHJ
(4) Whistle or audible signaling device
(5) PPE consistent with expected contaminated water

22.3.5* Organizations operating at the operations level shall be capable of operating at flood incidents that are limited to requiring a response based on surface water search and rescue operations capabilities on and around flood-affected areas.

22.3.6 Organizations at the operations level shall be permitted to support organizations operating at the technician level but shall not deploy into higher risk, difficult, or complex flood environments.

22.3.7 Organizations operating at the operations level at flood search and rescue incidents shall develop and implement procedures for the following:

(1) Identifying flood characteristics specific to the cause of the flooding and the geographic area flooded
(2) Operating surface support equipment used in flood search and rescue operations
(3)* Identifying and operating watercraft appropriate for use in the flood environment
(4)* Navigating through the flood-affected area
(5) Identifying potential sources of floodwater contamination
(6) Implementing decontamination procedures for personnel, casualties, and equipment

22.4 Technician Level.

22.4.1 Organizations operating at the technician level for flood search and rescue incidents shall meet the requirements in Section 8.4, Section 22.3, and 22.4.1 through 22.4.7.

22.4.2 Organizations operating at the technician level for flood search and rescue incidents shall apply the requirements of Section 8.4 under conditions representative of the flood environment.

22.4.3 Any member of the organization who might be expected to perform at the technician level for flood search and rescue shall be provided training to meet the job performance requirements for technician-level flood rescue as defined in NFPA 1006.

22.4.4 Organizations operating at the technician level at flood search and rescue incidents shall be capable of operating in, on, and around higher risk, difficult, or complex flood environments and shall have the following capabilities:

(1) Recognizing higher risk, difficult, or complex flood environments, and implementing systems to maximize the safety of responders
(2) Conducting search operations in areas affected by flood waters, including building and structure entries, as required to support the task
(3) Performing extrication and rescue operations involving packaging, treating, and removing victims trapped by floodwaters
(4) Transporting victims to a location where they can be removed from the flood-affected area

22.4.5 Organizations operating at the technician level at flood search and rescue incidents shall meet the requirements specified in this chapter, in the following chapters, and in NFPA 1006.

(1) Rescuers expected to enter the water in floodwater environments that present swiftwater hazards shall meet technician-level requirements of Chapter 10 of NFPA 1006.
(2) Organizations operating at the technician level at flood search and rescue incidents in areas where swiftwater hazards are present shall meet the technician-level requirements of Chapter 17, Swiftwater Search and Rescue.
(3) Organizations operating at the technician level at flood search and rescue incidents that operate with helicopters shall meet the requirements of Chapter 15, Helicopter Search and Rescue.

22.4.6 Organizations operating human-powered watercraft in a flood search and rescue environment shall develop and implement procedures for the use of human-powered watercraft in the flood search and rescue environment.

22.4.7 Organizations operating motorized watercraft in a flood search and rescue environment shall develop and implement procedures for the use of motorized watercraft in the flood search and rescue environment.

Chapter 23 Tower Search and Rescue

23.1 Prerequisites.

23.1.1* The requirements of this chapter shall apply to organizations that provide varying degrees of response to emergencies involving guyed, self-supporting, monopoles and non-standard tower structures.

23.1.2 Organizations operating at tower rescue incidents shall, as a prerequisite, meet the requirements specified in Chapter 4.

23.1.3 The AHJ, as part of its hazard identification and risk assessment (*see Section 4.2*), shall identify all locations and situations in the jurisdiction that meet the definition of *towers* and shall make reasonable effort to perform pre-incident rescue action plans with the tower owner, manager, operator, or other AHJ for potential tower emergencies.

23.2 General Requirements.

23.2.1* The rescue organization shall be capable of responding in a timely manner to rescue summons.

23.2.2* The AHJ shall ensure that all members of the tower rescue organization are equipped, trained, and capable of functioning to perform tower rescues within the area for which they are responsible at their designated level of competency.

23.2.2.1 The AHJ shall ensure that all members of the tower rescue organization who ascends a tower in the course of training or rescue is protected from a potential fall with equipment and methods that provide protection that is at least equivalent to the protection that would be expected or required for a worker on the same tower.

23.2.2.2 The AHJ shall ensure that each member of the tower rescue organization is provided with, and trained to use properly, the PPE and rescue equipment necessary for performing

rescue from towers according to the designated level of competency.

23.2.2.3 The AHJ shall ensure that a responder to any tower incident that also involves wilderness, water, confined space, machinery, or other disciplines addressed in NFPA 1670, shall also meet the applicable requirements of this standard in those areas.

23.2.3* The AHJ shall ensure that each member of the tower rescue organization is aware of the hazards that could be confronted when called upon to perform rescue in or on towers within the response area of the AHJ, including (but not limited to) RF.

23.2.3.1* The AHJ shall ensure that each member of the tower rescue organization who might be called upon to climb the tower is trained in accordance with the outlined requirements described in 23.4.4 for operations-level organizations or 23.5.4 for technician-level organizations.

23.2.3.2 The AHJ shall ensure that each member of the tower rescue organization is trained to identify, avoid, and protect against the following tower-specific hazards:

(1) Those associated with electrical energy, including alternating current (ac), direct current (dc), or fields generated by these currents
(2) Those associated with other types of electromagnetic radiation

23.2.3.3 The AHJ shall ensure that any member of the rescue organization who works in a position where he/she could be exposed to RF radiation (such as on a telecommunications tower) is equipped with and carries on his/her person an RF monitor and shall receive training on lockout/tagout procedures for telecommunications and broadcast towers.

23.2.4 The AHJ shall ensure that each member of the tower rescue organization designated to perform tower rescue shall practice performing tower rescues at a frequency of not less than once every 12 months, by means of simulated rescue operations in which dummies, mannequins, or persons are removed from actual towers or representative structures resembling the type(s), configuration(s), and accessibility of towers to which the tower rescue organization could be required to respond.

23.2.5* The AHJ shall establish a preplan for working with the utility providers in its area, and during any incident involving transmission towers shall consult with utility companies to identify and mitigate electrical hazards before attempting rescue on these or related structures.

23.2.6 The AHJ shall ensure that each member of the tower rescue organization is familiar with the medical conditions likely to exist in a tower rescue emergency (including but not limited to suspension intolerance, electrical burns, and RF exposure) and knows how to treat them during the operation.

23.3 Awareness Level.

23.3.1 Organizations operating at the awareness level for tower rescue incidents shall meet the requirements specified in Sections 23.2 and 5.2 (awareness level for rope rescue).

23.3.1.1 Members of organizations at the awareness level shall be permitted to assist in support functions on a tower rescue operation (such as ground support) but shall not be deployed onto the tower.

23.3.1.2* Organizations at the awareness level shall be responsible for removal or retrieval of the subject only in cases where climbing the tower is not required and fall hazards are eliminated.

23.3.2 Organizations operating at the awareness level for tower rescue incidents shall implement procedures for the following:

(1) Recognizing the need for tower rescue
(2) Initiating contact and establishing communications with a subject(s) where possible
(3) Initiating the emergency response system for tower rescue
(4) Recognizing different types and purposes of towers with consideration to the information covered in 23.2.3
(5) Performing a retrieval without ascending the structure or tower
(6) Initiating site control and scene management
(7)* Recognizing and identifying the hazards associated with tower emergencies
(8) Recognizing the limitations of conventional emergency response skills and equipment in various tower environments
(9) Initiating the collection and recording of information necessary to assist operational personnel in a tower rescue
(10) Identifying and securing any reporting parties and witnesses
(11) Establishing familiarity with lockout/tagout procedures

23.4 Operations Level.

23.4.1 Organizations operating at the operations level for tower rescue incidents shall meet the requirements specified in Sections 23.2, 23.3, 23.4, and 5.3 (operations level for rope rescue).

23.4.2 Operations-level organizations are restricted to tower rescue response where all of the following conditions are true:

(1) Where a climbing ladder, integrated tower safety system, or both, are present, and rescuers can access the subject using available PPE and tower climbing techniques consistent with the requirements set forth within this chapter
(2) Where the tower is not structurally compromised
(3) Where the climb path is not obstructed
(4) Where a rescue preplan exists for that particular tower site and advance preparation/planning has been performed with the tower owner/operator
(5) Where the subject can be reached and evacuation performed in accordance with the preplan in such a manner so as to avoid additional hazards, entanglement, or restrictions to the rescue effort
(6) Where the tower can accommodate two or more rescuers in addition to the victim
(7) Where all hazards in and around the tower have been identified, isolated, and controlled
(8) Where the operation is feasible using the equipment or systems with which the organization has been trained
(9) Where the height of the tower does not exceed 300 ft (91.44 m)

23.4.3* Organizations operating at the operations level shall ensure that a sufficient number of personnel who are trained and capable of ensuring an operations-level response are availa-

ble to respond to a tower incident at any given time and shall develop and implement procedures for the following:

(1)* Sizing up existing and potential conditions at tower incident sites
(2)* Protecting personnel from hazards on and around the tower environment
(3) Ensuring that personnel are capable of managing the physical and psychological challenges that affect rescuers accessing and climbing towers
(4)* Performing ongoing assessment of conditions affecting the tower rescue operation
(5)* Requesting and interfacing with specialized resources applicable to tower safety
(6) Placing a team of two rescuers on a tower where existing ladder or step bolts and climb protection are present, using accepted tower safety methods and procedures consistent with the requirements of 23.4.4
(7) Performing the following basic rescue techniques with two rescuers on the tower:
    (a) Releasing a subject from fall protection
    (b) Lowering a subject vertically down an unobstructed path
    (c) Performing a rescue of a subject where methods require up to a 15-degree deviation from plumb and can be performed with a tag line
(8) Performing selection, care, and use of personal tower climbing equipment
(9) Procuring the necessary tower-site information, including owner and lessor information, site plan, and specific hazard information
(10) Modifying actions and urgency as applicable to a rescue versus a recovery
(11) Acquiring information on current and forecast weather, including temperature, precipitation, lightning potential, and winds
(12) Recognizing, identifying, and utilizing typical fall protection and safety hardware and software used by tower climbers
(13)* Recognizing the team's limitations regarding accessing a subject, evacuating a subject, or both
(14) Recognizing and using engineered anchor points for the rescue operation
(15) Developing of and adhering to contingency plans for when weather or other factors make operations-level response ineffective or dangerous to rescuers

23.4.4 The AHJ shall ensure that each member of the operations-level tower rescue organization who might be responsible for ascending a tower for rescue shall, at a minimum, meet the requirements of operations-level tower rescue in NFPA 1006. Capabilities shall include, but not be limited to, the ability to demonstrate competency in the principles and use of the following:

(1) Job hazard analysis used on tower sites
(2) 100 percent fall protection
(3) Tower anchorages
(4)* Use of energy-absorbing lanyards
(5)* Use of work-positioning lanyards
(6)* Self-retracting lifelines
(7)* Vertical lifelines for fall arrest
(8)* Ladder climbing safety systems (cable and rail)
(9)* Use of a pre-climb checklist
(10)* Tower ladder/peg climbing techniques
(11) Transferring between the ladder and the tower structure
(12)* Selection and use of appropriate rescue equipment and techniques for a given tower rescue situation

23.5 Technician Level.

23.5.1* Organizations operating at the technician level shall be capable of performing and supervising all aspects of any tower rescue operation with which the organization could become involved.

23.5.1.1 Organizations operating at the technician level for tower rescue emergencies shall meet all of the requirements of this chapter plus the requirements of Section 5.4 (technician level for rope rescue).

23.5.2 Technician-level tower rescue capabilities are required for tower rescues where any one or more of the following conditions exist:

(1) Where a climbing ladder or climbing pegs are not present
(2) Where an integrated tower safety system is not present
(3) Where the tower is structurally compromised
(4) Where the site is affected by hazards other than those directly related to the tower or fall protection
(5) Where the climb path is obstructed
(6) Where a rescue preplan does not exist, has been compromised, is infeasible, and/or is not sufficient to resolve the problem at hand
(7) Where the tower cannot accommodate more than one rescuer in addition to the victim
(8) Where the use of standard subject packaging devices, systems, and/or procedures is infeasible
(9) Where the capabilities of operations-level skills are exceeded
(10) Where the height of the tower exceeds 300 ft (91.44 m)

23.5.3* Organizations operating at the technician level for tower rescue emergencies shall be capable of developing and implementing procedures for the following:

(1) Evaluating hazards and establishing a climb plan for an unfamiliar tower
(2) Isolating and controlling electrical hazards on an unfamiliar tower
(3) Identifying and controlling EMF/RF hazards on an unfamiliar tower
(4)* Accessing and rescuing from a tower using non-standard anchorages
(5) Planning and implementing response for tower rescues on unfamiliar towers where ascent of the tower is required
(6)* Placing at least one rescuer on the tower without the benefit of a ladder, step bolts, or integrated fall protection while maintaining 100 percent fall protection at all times
(7) Performing basic rescue techniques, including at least the following, with only one rescuer on the tower:
    (a) Releasing a subject from common types of fall protection, including a vertical lifeline (cable), vertical lifeline (rope), fall arrest lanyard, and SRL
    (b) Lowering a subject vertically down an obstructed path
    (c)* Performing a rescue where the subject must be moved horizontally as well as vertically

23.5.4 The AHJ shall ensure that any member of the technician-level tower rescue organization who might be

responsible for ascending a tower for rescue shall, at a minimum, meet the requirements of technician-level tower rescue in NFPA 1006. Capabilities shall include, but not be limited to, demonstrated competency in all of the capabilities outlined for operations level, plus the following:

(1)* Overseeing others who are using tower rescue equipment and techniques
(2)* Constructing or installing horizontal lifelines
(3)* Tower structure climbing techniques
(4) Transferring between different parts of the structures and between the structure and the rescue system
(5)* Selecting and using rescue equipment and techniques for a tower rescue situation that has not been preplanned

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.1 This standard was developed to define levels of preparation and operational capability that should be achieved by any authority having jurisdiction (AHJ) that has responsibility for technical rescue operations. These defined levels provide an outline of a system used to manage an incident efficiently and effectively, to maximize personnel safety, and to bring about the successful rescue of victims and the eventual termination of the event. The system should be followed to increase the capabilities of the AHJ to deal successfully with even the most complex incident. The system progresses from the simple basic awareness level to the operations level, and, finally, to the technician level. It should be understood that, as the system expands, the requirements for training, operational skills, management ability, and types and amounts of equipment also expand.

A.1.1.2 Organizations providing such rescue, fire suppression, and emergency services can include fire departments, law enforcement, emergency medical services, and utility, public works, and rescue organizations.

A.1.1.3 While organizations can meet the requirements of this standard, individuals and their skills and qualifications are outside of the scope of this document and are addressed in NFPA 1006.

A.1.2 An organization can achieve its desired level of operational capability through the use of external resources that operate at that desired level.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.10 Avalanche. A small, and often harmless, avalanche is called a "sluff."

A.3.3.11 Belay. This method can be accomplished by a second line in a raising or lowering system or by managing a single line with a friction device in fixed-rope ascent or descent. Belays also protect personnel exposed to the risk of falling who are not otherwise attached to the rope rescue system.

A.3.3.15 Body Substance Isolation. This equipment usually includes the use of fluid impervious gloves, goggles, masks, and gowns/coveralls.

A.3.3.17 Cave. Caves can breathe in and out, often creating a wind that can have a chilling effect on patients and rescuers. Caves can also include water features, including rivers, streams, or lakes and can have deep drops, some as deep as 500 ft (152.4 m).

A.3.3.22 Confined Space. This definition excludes mines and caves or other natural formations, all of which must be addressed by other specialized training and equipment.

In addition to those characteristics noted in 3.3.22, a confined space also has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere
(2) Contains a material that has the potential for engulfing an entrant
(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section
(4) Contains any other recognized serious safety or health hazards (including falling, environmental, and equipment hazards)

A.3.3.25 Coverage (sometimes called "coverage factor"). Defined as the ratio of the area effectively swept to the physical area of the segment that was searched as shown in the following equation:

[A.3.3.25]

$$Coverage = \frac{Area\ effectively\ swept}{Segment's\ Area}$$

Searching an area and achieving a coverage of 1.0 means that the area effectively swept equals the area searched. Note that this does not necessarily mean that every piece of ground was scanned, nor does it mean that the probability of detection

(POD) of a coverage 1.0 search is at or near 100 percent. Coverage is a measure of how thoroughly the segment was searched. The higher the coverage, the higher the POD will be. However, the relationship is not linear — that is, doubling the coverage does not double the POD.

Searcher-hours (number of searchers × time spent searching) are sometimes used to roughly suggest a level of coverage. For example, two persons spending 2 hours searching a specific property or segment could be said to have applied twice as much coverage as if two searchers spent 1 hour searching the same property or segment.

A.3.3.27 Critical Angle. When a rope (web) is connected between two points and a load placed in between, an angle is formed. This interior angle can act as a force multiplier. As the angle increases, the force directed along the rope (web) is amplified, increasing the force felt on the anchors. At 120 degrees, the force on each anchor is equivalent to the load. Beyond this point, such as with a high line, the force on each anchor rapidly increases. When a rope (web) is looped around an anchor point, a critical angle also can be formed. As the angle increases, the tension in the rope (web) increases, creating compression force on the anchor, but the tension on the anchor point remains the same. Table A.3.3.27 shows the relative force exerted on each anchor point in a two-point load-distributing anchor system where the load mass is 200 lb (90 kg) exerting 200 lbf (0.89 kN) of force at its attachment at varying angles *(also see Figure A.3.3.27)*.

A.3.3.37.1 90 Percent Diver. The intent is for this diver to be fully dressed, with the possible exception of fins and facemask, all safety checks performed, and all necessary equipment is on hand to perform the intended mission. The 90 percent diver can be in the water, on the shore, or in a vessel at the entry point.

A.3.3.37.2 Safety Diver. The intent is that this diver is positioned in such a manner that he or she can be deployed to the location of the submerged diver(s) as quickly as possible. This often requires the safety diver to be in the water with all equipment, including facemask, donned and safety checked, neutral buoyancy established, and immediately ready to submerge at the signal to deploy. The diver should be briefed in advance of potential dive-related hazards and the action required in response. In some cases, the diver might need to be aboard a vessel or on the shore.

Table A.3.3.27 Two-Point Anchor Systems Showing Relative Force

Angle (degrees)	Force at Each Anchor	
	lbf	kN
0	100	0.44
30	103	0.46
45	108	0.48
60	115	0.51
90	141	0.63
120	200	0.89
160	575	2.56
170	1,147	5.10
179	11,459	50.97

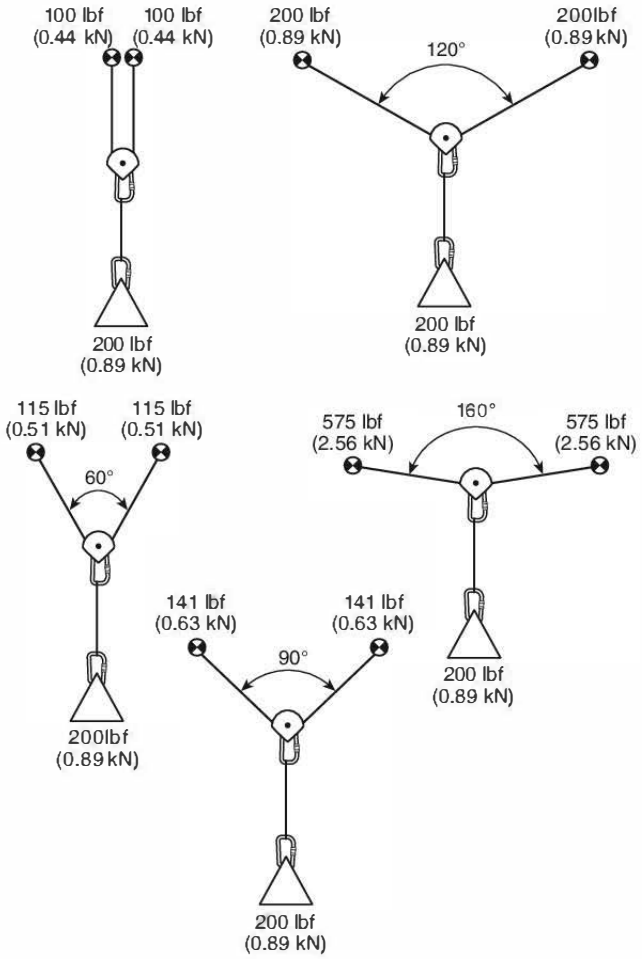

FIGURE A.3.3.27 Two-Point Anchor Systems Showing Relative Force.

A.3.3.43 Entry Permit. An entry permit authorizes specific employees to enter a confined space and contains specific information as required.

In certain industries, U.S. federal law does not require a permit system even though spaces meeting the characteristics of confined spaces as defined within this standard might be present. In these cases, as well as cases of unauthorized or nonregulated entry into confined spaces, a permit might not be available for reference by the rescue team. The space must be completely assessed before entry can be safely made. U.S. federal law does not require rescuers to have a permit to rescue, although it is advisable for the rescue team to follow similar procedures to ensure safety.

A.3.3.45 Environment. Examples include desert, alpine/mountain, arctic, rain forest, and seashore.

A.3.3.50 FEMA Task Force Structure/Hazard Evaluation Marking System. Markings are made by drawing a 2 ft × 2 ft (0.6 m × 0.6 m) square box and denoting in and around the box specific relevant hazard information (e.g., general level of operation safety, direction of safest entry, time and date of search, hazards found, team involved). Figure F.3(a) illustrates the structure/hazard evaluation marking system. For more

information, see *FEMA National Urban Search and Rescue (US&R) Response System.*

A.3.3.51 FEMA Task Force Structure Marking System, Structure Identification Within a Geographic Area. The primary method of identification includes the existing street name, hundred block, and building number. Structure identification within a geographic area is used to differentiate buildings by groups, such as by block(s) or by jurisdictional area. Figure F.4(a) illustrates the building ID and location marking system. For more information see *FEMA National Urban Search and Rescue (US&R) Response System*, Appendix C, "Task Force Building Marking System."

A.3.3.55 General Area. The general area is sometimes referred to as the "warm zone" and is usually the area 300 ft (90 m) in all directions from the incident site.

A.3.3.68 Incident Scene. The incident scene includes the entire area subject to incident-related hazards and all areas used by incident personnel and equipment in proximity to the incident.

A.3.3.69 Isolation System. Examples of isolation devices include concrete or steel pipe, corrugated pipe, concrete vaults, and other pre-engineered structures that sufficiently isolate and protect the victim.

A.3.3.70 Knot. Knots, bends, and hitches represent the three types of ties used to bind ropes and webbing. However, the term knot is sometimes used generically to refer to all types of rope or webbing ties.

A.3.3.71 Large Animal. It should be noted that the skill sets within this document can be applied to exotic/wild large animals such as tigers, antelope, bears, rhinos, and so forth with appropriate chemical restraint administered by an appropriate person as defined by the AHJ.

A.3.3.78 Lockout. Usually a disconnect switch, circuit breaker, valve, or other energy-isolating mechanism is used to hold equipment in a safe position. It can include the use of guards when other mechanisms are not available. However, the use of guards can violate federal lockout/tagout regulations in federally regulated facilities. Lockout is usually performed in combination with a tagout procedure.

A.3.3.80 Lowering System. Lowering systems should incorporate a mechanism to prevent the uncontrolled descent of the load during the lowering operation. This mechanism can reduce the need for excessive physical force to control the lowering operation.

A.3.3.84 Minimum Primary Reserve Pressure. For the purposes of this document, minimum primary reserve pressure is one third of the entire rated capacity of breathing gas available to the diver. In no case should the established minimum reserve pressure for the primary source of breathing gas be less than 500 psi.

Dive operations involve work in an IDLH environment. To ensure safe dive operations, all divers must plan their dives to maintain an adequate reserve to manage unforeseen circumstances.

The one-third reserve should be calculated in advance for specific sizes of the cylinders used by the team by using the total volume of air, including any redundant air systems, adjusted for the rated working pressure of the cylinders associated with the breathing gas systems. From that calculation, determine the primary system pressure that would leave the diver with approximately one third the total volume in reserve. It is not the intent to calculate the reserve pressure based on the actual pressure of the cylinder at the start of the dive but always with the rated working pressure of the cylinder.

A diver equipped with only a standard aluminum cylinder 80 gets 80 ft^3 (2.27 m^3) at 3000 psi. Because there is no redundant air supply (RAS), the entire reserve one-third volume of 26.6 ft^3 (0.74 m^3) must be carried in the primary system.

(26.6 ft^3 x 3000 psi)/80 ft^3 = 1000 psi

A diver equipped with an 80 ft^3 primary HP Steel and Pony cylinder with a working pressure of 3500 psi and 21 ft^3 (0.59 m^3) redundant air system cylinder has a total of 101 ft^3 (2.86 m^3). The diver needs to be on the surface with approximately 33.6 ft^3 (0.93 m^3) to meet the one third. Subtract the 21 ft^3 (0.59 m^3) provided in the RAS cylinder to leave 12.6 ft^3 (0.34 m^3) in the primary for the required reserve.

(12.6 ft^3 x 3500 psi)/80 ft^3 = 472 psi

Even though the calculated minimum surface reserve pressure is 472 lb (214 kg), the minimum permissible breathing gas pressure is 500 psi. In this case the diver's minimum primary reserve pressure is 500 psi.

Ensuring that divers comply with the required minimum reserve pressure is often a challenge to agencies that perform public safety diving. Ensuring that divers get adequate training using the established limits, including calculating additional air required to perform the ascent and relevant safety stops, is a key element to ensuring compliance. Training should be conducted at depths and under conditions that simulate an actual rescue environment while performing mission-specific work as often as possible so that divers can set proper expectations about air consumption and exertion levels. Instances where divers violate the minimum reserve pressure should be treated as a breach of policy, and the contributing factors should be documented to prevent recurrence. The AHJ is responsible for holding divers and supervisors accountable for compliance with established limits.

A.3.3.85 Mechanical Advantage (M/A). For example, a rope mechanical advantage system that requires only 10 lb (4.54 kg) of input force to produce 30 lb (13.6 kg) of output force has a 3:1 mechanical advantage [301 lbf (13.61 kgf), or 3:1]. Likewise, a system that requires 30 lb (13.6 kg) of input force to produce 30 lb (13.6 kg) of output force has a 1:1 mechanical advantage. There is no such thing as zero mechanical advantage. Other factors can affect the efficiency of a mechanical advantage system, including friction and drag created by the equipment. For purposes of this document, these factors are not considered and so the mechanical advantage is theoretical rather than actual. Rope-based mechanical advantage systems are generally classified as simple, compound or complex.

A.3.3.87 Multiple-Point Anchor System. The subcategories of this type of system can be further defined as follows:

(1) Load-distributing anchor systems (also referred to as self-equalizing or self-adjusting) are anchor systems established from two or more anchor points that meet the following criteria:

(a) They maintain near-equal loading on the anchor points despite direction changes on the main line rope.
(b) They re-establish equal loading on remaining anchor points if any one of them fails. The system should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

(2) Load-sharing anchor systems are established from two or more anchor points that distribute the load among the anchor points somewhat proportionately but will not adjust the direction changes on the main line rope. The system should be configured so as to limit the resulting drop that occurs as the result of an anchor point failure.

A.3.3.88 National Response Framework. The National Response Framework replaces the National Response Plan (NRP) and is available at http://www.fema.gov/emergency/nrf/. In recent years, the United States has faced an unprecedented series of disasters and emergencies, and as a result U.S. response structures have evolved and improved to meet such threats. This framework represents a natural evolution of the national response architecture. Although the NRP was called a plan, it was actually a framework written to guide the integration of community, state, tribal, and federal response efforts. Adopting the term *framework* within the title now aligns the document with its purpose. The purpose of the National Response Framework is to establish a comprehensive, national, all-hazards approach to domestic incident response. The framework is written for senior elected and appointed leaders, such as federal agency heads, state governors, tribal leaders, and mayors or city managers — those who have a responsibility to provide for effective incident management. At the same time, it informs emergency management practitioners, explaining the operating structures and tools used routinely by first responders and emergency managers at all levels of government.

A.3.3.89 National Search and Rescue Plan. According to this plan, all maritime or navigable water search and rescue (SAR) is the responsibility of the U.S. Coast Guard, and all inland SAR is the responsibility of the U.S. Air Force.

A.3.3.95 Personal Protective Equipment (PPE). PPE includes protective apparel (e.g., clothing, footwear, gloves, and headgear) as well as personal protective devices (e.g., goggles, face shields, hearing protectors, and respirators). Adequate PPE should protect the respiratory system, skin, eyes, face, hands, feet, body, and ears.

A.3.3.99 Primary Search. In a structural collapse situation, a primary search is a relatively fast-paced scan of the surface of debris and selected void spaces in and around structures that can be accomplished simultaneously with a reconnaissance operation. The size and makeup of a team established for primary search purposes should be incident-driven and flexible and can include physical, canine, and technical search resources. During this type of operation, victim locations are marked and reported, and appropriate resources are called in to further locate and/or extricate victims while the primary search continues.

A.3.3.100 Protective System. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

A.3.3.103 Raising System. Raising systems should incorporate a mechanical means to prevent the load from falling should the primary control mechanism be released during the raising operation.

A.3.3.105 Reconnaissance (Recon). A recon operation is not a search. It is a fast visual check of an entire area with the intention of obtaining information about the area. During a recon operation, no SAR tactics are performed. The size and makeup of a team established for recon purposes should be incident-driven and flexible and can be deployed on land, in or on water, or by air.

A.3.3.107 Redundant Air System. This breathing gas system is typically configured with a "pony" cylinder connected to a first- and second-stage regulator, which is then attached to the buoyancy compensator or strapped to the primary cylinder. It is intended to provide a source of air that is independent from any failure in the primary delivery system; as such it is not typically intended to be connected to the primary system by a block or other device unless one of the following occurs:

(1) The device is constructed with a feature that prevents the contents of the reserve cylinder from free flowing out a breach in the primary delivery system, such as a full facemask (FFM).
(2) The device is in addition to a conventional second stage.

A.3.3.108 Registered Professional Engineer. A registered professional engineer registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for manufactured protective systems or tabulated data to be used in the construction of protective systems.

A.3.3.110 Rescue Area. Sometimes rescue area is generally defined as an area 50 ft (15 m) in all directions from the incident site, or a distance in all directions equal to the height of the structure involved in the collapse plus a third.

A.3.3.115 Rescue Team. The number of persons required for an effective team is dependent upon variables such as the task(s) to be completed, the abilities of the individual team members, and the individuals' ability to work together efficiently. Although many recommendations exist as to an "ideal" minimum number of team members, this should be based on the circumstances surrounding the incident and the logistics involved.

A.3.3.117 Retrieval System. In U.S. federally regulated industrial facilities, these systems are required whenever an authorized entrant enters a confined space unless the retrieval system would increase the overall risk of entry or would not contribute to the rescue of the entrant. For confined space rescue operations, these systems should be in place prior to entry (into vertical or horizontal spaces) in such a manner that retrieval of rescue entrants can begin immediately in the event of an emergency. Retrieval systems can also be used to act as fall-arresting devices for rescue personnel.

A.3.3.119 Risk/Benefit Analysis. Traditionally in search and rescue, this analysis involves the assessment of the general status of the victim(s) in order to apply the proper urgency to the situation (rescue versus body recovery). A live victim suggests a rescue and its associated high level of urgency. A deceased victim, however, requires a body recovery, which suggests a far less urgent response.

A.3.3.126 Secondary Search. See A.3.3.25, Coverage.

A.3.3.128 Shield (or Shield System). Shields can be permanent structures that are designed to be portable and moved along. Shields can be either manufactured or job-built in accordance with 29 CFR 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

A.3.3.137 Strongback. Uprights placed so that the individual members are closely spaced, in contact with, or interconnected to each other are considered "sheeting."

A.3.3.138 Supplemental Sheeting and Shoring. Supplemental sheeting and shoring requires additional training beyond that of traditional sheeting and shoring.

A.3.3.142 System Safety Factor. Determining the system safety factor requires the evaluation of the strength of the components within the system, how their configuration reduces their strength, and the effects of force multipliers. The system strength is determined by first evaluating the strength of all parts of the system. This is then compared to the expected force applied, which is expressed as a ratio. The lowest ratio found in the system is the weakest link and, therefore, the system safety factor.

Examples of configurations that decrease the strength of components include, but are not limited to, the following:

(1) Knots in the rope
(2) Ropes traversing sharp edges
(3) Cross-loaded carabiners
(4) Pulleys used to change direction
(5) Environmental concerns, in particular water
(6) Angles between components that increase the forces on the components or the anchors
(7) Vector forces on ropes tensioned at both ends such as high-lines

A.3.3.144 Tabulated Data. The term is also applied to six tables found in Appendix C of 29 CFR 1926, Subpart P.

A.3.3.147 Technical Search and Rescue Incident. Technical rescue incidents can include water rescue, rope rescue, confined space rescue, wilderness search and rescue, trench rescue, vehicle and machinery rescue, dive search and rescue, collapse rescue, and other rescue operations requiring specialized training.

A.3.3.149 Terrain. Examples include cliffs, steep slopes, rivers, streams, valleys, fields, mountainsides, and beaches.

A.3.3.150 Terrain Hazard. Examples include cliffs, caves, wells, mines, avalanches, and rock slides.

A.3.3.151 Traditional Sheeting and Shoring. Some newer-style sheeting and shoring might not require a strongback attachment (refer to manufacturer recommendations).

A.3.3.153 Trench (or Trench Excavation). In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is no greater than 15 ft (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 ft (4.6 m) (or less, the excavation is also considered a trench.

A.3.3.155 Tunnel. The health and safety regulations regarding the construction of tunnels apply to all excavations that are, or will be, connected to the tunnel, including shafts and trenches.

A.3.3.159 Wilderness. The wilderness often includes a collection of various environments such as forests, mountains, deserts, natural parks, animal refuges, rain forests, and so forth. Depending on terrain and environmental factors, the wilderness can be as little as a few minutes into the backcountry or less than a few feet off the roadway. Incidents with only a short access time could require an extended evacuation and thus qualify as a wilderness incident. Extreme weather or other disasters can cause urban areas to share many characteristics with the wilderness.

Situational and incident examples are the Space Shuttle Columbia recovery, Katrina flood areas, law enforcement tactical unit operations, terrorist-type events, hurricanes, earthquakes, and other disasters.

Note that item (3) in the definition is not referring to the environmental definition of wilderness as a roadless area, but as a wild environment.

A.4.1.1 Safe operations at technical rescue incidents should include the assessment and acquisition of external resources required for situations beyond the operational capability of the organization. For example, a situation in a confined space or trench might require a technician-level hazardous materials response capability.

A.4.1.3 Responding organizations should focus their resources on the types of incidents and levels of response that are most appropriate for their response area. In many cases, it is better to rely on another responding organization for a given type of response when the number of incidents responded to in that discipline does not support the time and expense of maintaining the necessary level of proficiency.

A.4.1.4(1) This level can involve search, rescue, and recovery activities. Members of a team at this level are generally not considered rescuers.

A.4.1.4(2) This level can involve search, rescue, and recovery activities, which are usually carried out under the supervision of technician-level personnel.

A.4.1.5 A technician is a person who knows the subject matter thoroughly or knows where to get the answer quickly. He or she also can think through problems that have never (or rarely) been seen before and is comfortable in that environment. This ability might have been achieved through experience, including numerous operations in that discipline and/or through extensive, repetitive training in realistic scenarios of that discipline.

A.4.1.9 Basic life support (BLS) is the minimum level of medical care required; advanced life support (ALS) is recommended. The AHJ should consider the development of an advanced capability in medical response to reflect the needs of the technical rescue environment.

The AHJ, in addition to BLS training, should provide training in the treatment of the following medical conditions:

(1) *Cervical/Spinal Immobilization.* Training should be integrated with systems for vertical and horizontal patient evacuations (e.g., patient packaged onto a stokes stretcher and secured to provide spinal immobilization).
(2) *Crush Injury Syndrome.* Training should include recognition, evaluation, and treatment, prior to extrication, of victims with symptoms or mechanisms of injury potential.

(3) *Amputation.* Amputation should be considered as a last resort, but rescuers should be aware of the possibility. Incident managers also should be aware of the proper procedures to be followed in their community, including interaction with local medical doctors.
(4) *Infection Control.* Training should include education in protective equipment (e.g., gloves, masks, PPE), protective procedures (e.g., avoiding contaminants and pollutants), and appropriate decontamination following possible exposures, as specified in NFPA 1581 or in OSHA's "Blood-Borne Pathogens" standard (29 CFR 1910.1030).
(5) *Critical Incident Stress.* Training should include information on personal well-being, with emphasis on preconditioning, pacing of effort, proper diet and rest, and emotional and psychological diversions during long-term operations. Personnel should be trained to recognize the signs and symptoms of critical incident stress. Scene managers should be trained in the value of rehabilitation efforts during extended operations for the safety and continued efficiency of their personnel.

A.4.1.10.2 Organizations should provide ongoing training commensurate with proficiency to the identified operational level of capability in each applicable technical search and rescue discipline. The amount and frequency of this continuing education required is commonly based on criteria such as the current competency and aptitude of the team, fiscal constraints, and time constraints. However, this standard provides that the AHJ utilize performance-based evaluation as the primary basis for the amount and frequency of training required to meet this standard. Organizations demonstrating poor performance during evaluation imply a need for a greater amount and/or frequency of training.

A.4.1.10.4 In all types of search and rescue incidents, the potential exists for extenuating circumstances that would require expertise beyond the normal capability of the organization to operate safely. Examples of these situations include, but are not limited to, the following:

(1) *Structural Collapse.* Multiple collapse sites, large number of victims, numerous deeply buried victims, multiple complications (e.g., both deeply buried victims and multiple sites), involvement of hazardous/toxic substances, or severe environmental conditions (e.g., snow and rain)
(2) *Rope Rescue.* Lowering and raising operations requiring significant obstacle negotiation, descending or ascending operations from extreme heights, or severe environmental conditions (e.g., snow and rain)
(3) *Confined Space Search and Rescue.* Deep or isolated spaces, multiple complicating hazards (e.g., water, chemicals, and extreme height in a space), failure of essential equipment, or severe environmental conditions (e.g., snow and rain)
(4) *Vehicle and Machinery Search and Rescue.* Complex and/or unusual machinery, unusual vehicles, unusual locations of either machinery or vehicles, multiple complicating hazards (e.g., water, chemicals, and extreme height), failure of essential equipment, or severe environmental conditions (e.g., snow and rain)
(5) *Water Search and Rescue.* Depth, current, water movement, water temperature extremes, or severe environmental conditions (e.g., snow and rain)
(6) *Wilderness Search and Rescue.* Isolated and remote environments and extremes of environmental conditions (e.g., snow, rain, altitude)
(7) *Trench and Excavation Search and Rescue.* Very deep trenches, unusually shaped excavations, multiple complications (e.g., deep excavation and fluid soil), involvement of hazardous/toxic substances, completely buried subjects, or severe environmental conditions (e.g., snow and rain)

These conditions should be evaluated during the pre-incident risk assessment and on an incident-by-incident basis.

A.4.1.10.5 This documentation should contain each recipient's name, the signatures or initials of the trainers, the dates of training, an outline of the training conducted, and resource materials used to develop the training.

A.4.1.13 Legal considerations have an impact on many phases of a technical rescue incident (e.g., confined space regulations, use/maintenance of SCBA, right-of-entry laws during a search, right-to-privacy laws during an investigation). Whatever the capacity in which a rescuer functions (public or private), it is important that the rescuer be informed regarding all relevant legal restrictions, requirements, obligations, standards, and duties. Failure to do so could jeopardize the reliability of any investigation or operation and could subject the rescuer to civil liability or criminal prosecution.

A.4.1.14 Personnel involved in search and rescue (SAR) in the United States, and in other countries that have adopted its use, should also familiarize themselves with the *International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual* and the *U.S. National Search and Rescue Supplement* (NSS) *to the IAMSAR* (soon to be renamed the *National SAR Manual*).

The *IAMSAR Manual* is a three-volume set of reference materials jointly published by the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). It was intended for use by all countries and provides implementation guidance for the *U.S. National Search and Rescue Plan* (2007).

The NSS, prepared under the direction of the National Search and Rescue Committee (NSARC), provides guidance to federal agencies concerning implementation of the National Search and Rescue Plan. The NSS provides specific additional national standards and guidance that build upon the baseline established in the *IAMSAR Manual* and provides guidance to all federal forces, military and civilian, that support civil search and rescue operations.

A.4.2.1 A hazard identification and risk assessment is an evaluation and analysis of the environment and physical factors influencing the scope, frequency, and magnitude of technical rescue incidents and the impact and influence they can have on the ability of the AHJ to respond to and safely operate at these incidents.

The goal and terminal objectives of the hazard identification and risk assessment are to increase the awareness of the AHJ and to provide a focus toward conditions and factors associated with potential technical rescue responses.

The hazard identification and risk assessment can be associated closely with similar functional and format methodology, as might be incorporated in a master plan or strategic deployment study. It is not the intent of this standard to encumber

the AHJ in its undertaking of a detailed and extensive analysis of each technical rescue environment within the jurisdiction; rather, this standard is meant to provide means for a deliberate and objective examination of common or unique factors that can be identified, correlated, or highlighted to aid in the development of technical rescue capabilities and to determine their necessary level of expertise to provide risk reduction.

The hazard identification and risk assessment determines "what" can occur, "when" (how often) it is likely to occur, and "how bad" the effects could be. For certain of the hazards identified, it will be determined after this preliminary analysis that it is not necessary to carry out a full analysis. For such hazards, no further action is required.

The hazard identification should include, but not be limited to, the following types of potential hazards:

(1) Natural events
    (a) Drought
    (b) Fire (forest, range, urban)
    (c) Avalanche
    (d) Snow/ice/hail
    (e) Tsunami
    (f) Windstorm/tropical storm
    (g) Hurricane/typhoon/cyclone
    (h) Biological
    (i) Extreme heat/cold
    (j) Flood/wind-driven water
    (k) Earthquake/land shift
    (l) Volcanic eruption
    (m) Tornado
    (n) Landslide/mudslide
    (o) Dust/sand storm
    (p) Lightning storm
(2) Technological events
    (a) Hazardous material release
    (b) Explosion/fire
    (c) Transportation accident
    (d) Building/structure collapse
    (e) Power/utility failure
    (f) Extreme air pollution
    (g) Radiological accident
    (h) Dam/levee failure
    (i) Fuel/resource shortage
    (j) Business interruption
    (k) Financial collapse
    (l) Communication
(3) Human events
    (a) Economic
    (b) General strike
    (c) Terrorism (eco, cyber, nuclear, biological, and chemical)
    (d) Sabotage
    (e) Hostage situation(s)
    (f) Civil unrest
    (g) Enemy attack
    (h) Arson
    (i) Community-wide panic
    (j) Special events

There are a number of methodologies and techniques for risk assessment that range from simple to complex. These techniques include, but are not limited to, the following:

(1) What-if
(2) Checklist
(3) Hazop, hazard, and operability studies
(4) Failure modes and effect analysis
(5) Fault tree
(6) Failure-logic diagrams
(7) Dow and bond indices
(8) Event tree analysis
(9) Human reliability analysis
(10) Capability assessment readiness for state and local governments

A.4.2.3 As part of the risk assessment, the AHJ should identify the types of internal resources immediately available, within the operational structure of the organization, that could be utilized for technical search and rescue incident response. The resource list should include the availability of personnel, training levels of personnel, professional specialty or trade skills, and type, quantity, and location of equipment, appliances, and tools applicable to technical search and rescue incident response.

A.4.2.4 See Annex D.

A.4.2.5 The intent of this provision is to establish procedures to enable the incident commander to obtain the necessary resources to augment the internal capabilities of the AHJ. These resources can include, but are not limited to, the following:

(1) Mutual aid agreements
(2) Agreements with the private sector, including the following:
    (a) Organizations specializing in the specific skills and/or equipment required to resolve the incident
    (b) Special equipment supply companies
    (c) Related technical specialists
    (d) Communications
    (e) Food service
    (f) Sanitation
(3) Memorandums of Agreement (MOA) with other public, state, or federal agencies

A.4.4.1.1 Specific specialized equipment that might be required for safe technical rescue operations includes the following:

(1) Supplied line breathing apparatus (SLBA), supplied air breathing apparatus (SABA), and supplied air respirator (SAR), all of which should meet the requirements of 29 CFR 1910.146, "Permit-Required Confined Spaces"
(2) Personal alert safety system (PASS), which should meet the requirements of NFPA 1500 and NFPA 1982
(3) Life safety ropes and system components, which should meet the requirements of NFPA 1500, and NFPA 1983
(4) Communications equipment, which should meet the requirements of 29 CFR 1910.146
(5) Lighting equipment (e.g., flashlights, helmet-mounted lamps), which should be, depending on the situation, intrinsically safe or explosionproof as defined by 29 CFR 1910.146, and should be evaluated by the AHJ as to the appropriateness of the equipment at an emergency incident with regard to the existing hazards

A.4.4.2.1 Protective equipment should be appropriate to the tasks that are expected to be performed during technical search and rescue incidents and training exercises.

A.4.5.1.4 BLS is the minimum level required; advanced life support (ALS) is recommended.

A.4.5.1.5 Interagency cooperation is essential to the successful mitigation of many technical rescue incidents. Personnel from fire, rescue, emergency medical services (EMS), and law enforcement can be involved in an operation at all levels, from recognition through command. It is recommended that all agencies involved in rescue review and/or develop policies regarding control of firearms. The complete exclusion of firearms might not always be practical and/or feasible on the incident scene but is generally recommended.

A.4.5.3.1 The incident management system (IMS) utilized at all technical search and rescue incidents should be structured to address the unique groups, divisions, or branches that can be necessary to effectively manage the specific type of incident (e.g., structural collapse, trench/excavation cave-in). Managing external influences such as family, news media, and political entities involves instructing subordinates in how to deal with them should they be encountered. NFPA 1561 in 5.9.4.5, describes the use of an information officer (a member of the command staff) to address these types of influences. Where encounters with family, news media, or political influences are likely, such a function should be filled as soon as possible.

A.4.5.4 The AHJ should address the possibility of members of the organization having physical and/or psychological disorders (e.g., physical disabilities, fear of heights, fear of enclosed spaces) that can impair their ability to perform search and rescue in a specific environment.

Organizations are encouraged to adopt language similar to that included in Chapter 10, Medical and Physical Requirements, of NFPA 1500 regarding their medical and physical requirements.

A.4.5.5.1 These incidents can be caused by natural, accidental, or intentional means.

A.5.1.2 While rope rescues by themselves do not generally involve searches, it is appropriate for the AHJ to consider the environment in which rope rescues might occur and to assess the relative need. For example, high- and low-angle incidents occurring within certain environments can involve a significant search component (such as wilderness or structural collapse covered in other chapters of this document). Once located, the victim might then require the capabilities of rope rescue stated within Chapter 5.

A.5.1.3 It is important that organizations training rope rescue teams recognize the significance of, not only having a team perform the techniques required, but also assuring they are able to do so within a time frame and manner that would provide the best profile for successful rescue. The elements of timeliness and efficiency are paramount to assure this success. For example, a team that is required to construct and operate a rescue system will not benefit themselves or the victim unless they are required to do so quickly enough that the victim, under usual circumstances, would still be considered viable. Organizations should establish measurable standards for completion of required techniques within a given time frame based on the response conditions and nature of the anticipated emergency.

A.5.2.2(2) The intent of this provision is to establish procedures to enable the incident commander to obtain the necessary resources to augment the internal capabilities of the AHJ. These resources can include, but are not limited to, the following:

(1) Mutual aid agreements
(2) Agreements with the private sector, including the following:
    (a) Construction industry
    (b) Demolition industry
    (c) Heavy equipment operators
    (d) Special equipment supply companies
    (e) Hardware, lumber, and construction suppliers
    (f) Consulting engineers and architects
    (g) Related technical specialists
    (h) Communications
    (i) Food service
    (j) Sanitation
(3) Memorandums of Agreement (MOA) with other public, state, or federal agencies

A.5.2.2(3) The emergency response system includes, but is not limited to, operations- and technician-level personnel capable of responding, as well as local, state, and national resources.

A.5.2.2(4) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This process might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.5.2.2(5) General hazards associated with rope rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *Fall Hazards.* Rope rescue incidents are often required in areas where an elevation differential exists. Therefore, the possibility of someone falling, or something falling on someone, should always be considered and mitigated.
(2) *Other Hazards.* There are numerous other hazards associated with rope rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards to perform rescue operations safely and effectively.

The "general area" around a rope rescue scene is the entire area within 300 ft (91.44 m) (or more, as established by the incident commander). Making the general area safe can include, but is not necessarily limited to, the following:

(1) Controlling/limiting traffic and sources of vibration in the area
(2) Controlling/limiting access to the area by unnecessary personnel
(3) Identifying hazards and removing and/or reducing their impact

A.5.2.2(6) Other than that described in 4.4.2, specific PPE necessary for safe rope rescue operations can include, but is not limited to, the following:

(1) Harnesses
(2) Gloves appropriate for rope rescue work
(3) Helmets designed for climbing and rope rescue work

A.5.3.2 A team should prove its capability through demonstrating the ability to move a rescue load over a minimum specified distance. These distances must reflect the potential height/depth consistent with the man-made and natural struc-

tures within the response area and confirm the team's ability to meet its response needs. It is generally recommended that organizations establish a minimum travel distance for applicable techniques appropriate to the AHJ's hazard analysis.

The overall intent of the operations level in rope rescue is to have the capability to transport the rescuers and/or the victim from one stable location to another, from either above or below the position of the victim.

For the purposes of this section a "stable location" is represented by an environment where the terrain or surroundings do not present an imminent fall hazard requiring the use of a high-angle rope rescue system to support or prevent the fall of the rescuer or victim.

A.5.3.2(8) Multiple-point anchor systems at the operations level are intended to focus or position the application point of the anchor, excluding the combination of marginal anchor points.

A.5.3.2(9) Belay systems are a component of single-tensioned rope systems, which apply a tensioned main system upon which the entire load is suspended and a nontensioned system with minimal slack (belay) designed, constructed, and operated to arrest a falling load in the event of a main system malfunction or failure. While these traditional systems used for lowering and hauling are in common use, two-tensioned rope systems could also be used to suspend the load while maintaining near equal tension on each rope, theoretically reducing the fall distance and shock force in the event of a single rope failure. To be effective, two-tensioned rope systems must utilize devices that will appropriately compensate for the immediate transfer of additional force associated with such failures.

A redundant system might include any system that provides for a belay in the event of a single system failure. In the case of single-tensioned rope systems, this is most commonly a belay system, which, by definition within this document, is a nontensioned, manually operated system designed to belay a load.

Although both lines are under tension, two-tensioned rope systems also provide a belay, which, by definition within this document, is the method by which a potential fall distance is controlled to minimize damage to equipment and/or injury to a live load.

The requirement in 5.3.2(9) is not intended to restrict a rescue team from using two-tensioned rope systems that can be used anywhere rope-based lowering or hauling systems are required.

A.5.3.2(12) The term self-rescue applies to situations where conditions affecting individual team members have created an emergency that they should be able to mitigate without the aid of others. These conditions can include, but are not limited to, climbing equipment malfunctions and certain entanglement hazards.

A.5.3.2(13) The requirement in 5.3.2(13) is not intended to restrict a rescue team from using two-tensioned rope systems that can be used anywhere rope-based lowering or hauling systems are required.

A.5.3.2(16) The requirement in 5.3.2(16) is not intended to restrict a rescue team from using two-tensioned rope systems that can be used anywhere rope-based lowering or hauling systems are required.

A.5.3.2(17) Item 5.3.2(17) is intended to address the movement of a loaded litter over an edge during high-angle operations. This could require constructing systems well above the edge to facilitate safe movement over the edge, or the application of techniques where there are no overhead structures.

A.5.4.2 Organizations wishing to perform rope rescues at the technician level should train and equip personnel to provide the required capabilities.

A.5.4.2(1) These techniques typically rely on the rescuer's ability to climb or rest on a structure or natural terrain that presents a significant fall hazard and requires specialized tools or training to protect the rescuer from the effects of a fall. These might include, but are not limited to, conventional lead climbing with a bottom belay, use of double lanyards, positioning belts, shepherd's hook or click sticks, and top belay methods.

A.5.4.2(2) This procedure is meant to encompass systems such as, but not restricted to, high lines, two-rope offsets, deflection, tracking, and guiding lines. A rope or similar line that is connected directly to the load being raised or lowered (often referred to as a tag line) and effectively managed by a rescuer to pull the load out and away from simple inline projections or obstructions is not intended to be a technician-level function.

A.5.4.2(3) This requirement is intended to address situations such as a patient suspended from a piece of fall protection or a piece of functional or nonfunctional climbing equipment, or entangled in, or clinging to, some part of a structure or landscape feature.

A.6.2.2(2) See A.5.2.2(2).

A.6.2.2(3) The emergency response system includes, but is not limited to, operations- and technician-level personnel, as well as local, state, and national resources.

A.6.2.2(4) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This activity might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.6.2.2(5) See Annex E.

A.6.2.2(6) See Annex I.

A.6.2.2(7) Indications of potential for secondary collapse include, but are not limited to, the following:

(1) Leaningwalls
(2) Smoke or water seeping through joints
(3) Unusual sounds (e.g., creaking, groaning)
(4) Recurring aftershocks
(5) Sagging floor or roof assemblies
(6) Missing, strained, or damaged points of connection of structural elements
(7) Excessive loading of structural elements
(8) Sliding plaster and airborne dust
(9) Separating walls
(10) Lack of water runoff
(11) Racked or twisted structure
(12) Building vibration

A.6.2.2(8) Procedures for conducting searches should include, at a minimum, visual and verbal methods.

Search and rescue operations in the structural collapse environment should include close interaction of all IMS elements for safe and effective victim extrications. Search operations for locating victims should be initiated early at a structural collapse incident. Structural collapse search operations should conform to an accepted system for victim search strategy and tactics to achieve optimum performance and effectiveness. The following recommendations provide current tactical capabilities and general strategies that can assist personnel in productive search operations.

Structural collapse operations are one of the most difficult rescue situations likely to be encountered. Depending on the complexity of the search and rescue activity, personnel might need to spend large amounts of precious time on small numbers of difficult rescues. It is important to establish whether or not rescue personnel are involved with a live victim, since the rescue of living victims should be prioritized ahead of the recovery of the remains of deceased victims.

A.6.2.2(9) See Annex F.

A.6.2.2(11) In most incidents, the collapse zone is the height of the remaining building, or building elements, plus ⅓ that height. The same is true in situations where there is a total collapse and no standing remains or where there are remains that could collapse or slide, affecting the safety of the rescuers or the operation.

A.6.2.2(12) At the awareness level, possible reconnaissance should be performed from outside the collapse zone.

A.6.3.3(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident
(2) Risk assessment and benefit analysis
(3) Number and size of structures affected
(4) Integrity and stability of structures affected
(5) Occupancy types (e.g., residential, mercantile)
(6) Number of known and potential victims
(7) Access to the scene
(8) Environmental factors
(9) Available and necessary resources

A.6.3.3(2) Unique collapse or failure hazards can include, but are not limited to, large precariously hanging objects, extremely unbalanced floor sections where any additional weight could cause the floor section to shift or slide, or large multi-story openings or holes.

A.6.3.3(3) Organizations at the operations level should be capable of obtaining and/or utilizing one or more of the following search resources:

(1) Structural collapse search dogs
(2) Search cameras
(3) Acoustic/seismic instruments (listening devices)
(4) Thermal imaging or infrared devices
(5) Other technical search devices
(6) GPS and GIS technology
(7) Technical search specialist(s)

Some explanation of the coverage associated with various search operations is included in A.3.3.25 under the definition for the term *coverage*.

Search operations should incorporate a variety of technical and nontechnical methods that might provide personnel with the only viable method to locate victims and determine their status.

The AHJ should identify forms of technical and nontechnical search capabilities available at the local, regional, state, or national level that are commensurate with its needs. In addition to the basic operational level of capability, search methods should include, but not be limited to, the following:

(1) *Structural Collapse Search Dogs.* This involves the use of air-scent dog and handler teams trained and equipped specifically to search collapsed structures. The dog and the handler work as a team to identify the location and status of victims buried beneath rubble or structural components. It is important that the AHJ differentiate between structural collapse search dogs and other "air-scenting" dogs such as those used to search for drugs and explosives, cadaver dogs, and police K-9.
(2) *Electronic Search.* This involves the use of acoustic/seismic devices and includes the deployment of an array of two or more pickup probes around the perimeter of a collapsed structure or void area.
(3) *Search Cameras.* This involves the placement of a search camera device within a void area to search "visually" a previously nonvisible collapse zone. To use this device, ancillary tools such as rotary hammers, drills, or breakers are needed to create an opening through which the camera can be passed.
(4) *Air Sampling.* Identification of high concentrations of CO_2, for example, might indicate the presence of a live victim.

Once the AHJ has identified the location and availability of these search options at a structural collapse incident, a system should be developed to place them into operation. In conjunction with the capability of the AHJ to place into operation one or more of the previously described search methods, organizations should implement a strategic and tactical plan for the use of these devices as quickly as possible. Organizations should coordinate all available and viable tactical capabilities into a logical plan of operation. It is essential that the AHJ employ every possible search method to ensure that its members are able to locate viable victims before committing rescue resources to any prolonged (even if well-intentioned) operation. Large disaster environments can have much in common with a wilderness environment. Thus, where wide area searches are conducted in this type of environment, the use of some of the wilderness search and rescue requirements of this standard can promote rescuer safety and effectiveness.

A.6.3.3(4) Access training should include, but not be limited to, the safe and effective implementation of the following:

(1) Techniques to lift structural components of walls, floors, or roofs
(2) Rescue shoring techniques to construct temporary structures needed to stabilize and support structural components that prevent movement of walls, floors, or roofs in order to stabilize the structure and access the victims
(3) Breaching techniques to create openings in structural components of walls, floors, or roofs
(4) Operation of appropriate tools and equipment to accomplish the above tasks

A.6.3.3(5) Extrication operations at a structural collapse incident necessitate a coordinated effort that includes search, rescue, and medical capabilities. Organizations should have a

working knowledge of general extrication tactics and procedures. These tactics and procedures should be flexible enough to address the specific situation and problems encountered. The AHJ should provide the appropriate training and equipment necessary to complete an extrication operation safely and effectively. These should include the following:

(1) *Manual.* Training should be provided in safe lifting techniques necessary to move manageable sections of debris and interior contents displaced by partial or complete structural collapse.
(2) *Hand Tools.* Tools and training necessary to move debris, room contents, and structural components displaced by partial or complete structural collapse should be provided. Hand tools should include, but not be limited to, pry bars, bolt cutters, jacks, and sledge hammers. Training requirements should be coordinated with the hand tool inventory.

Extrication training should include the following, as a minimum:

(1) Packaging victims within confined areas
(2) Removing victims from elevated or belowgrade areas
(3) Providing initial medical treatment to victims
(4) Operating appropriate tools and equipment to accomplish the above tasks safely and effectively

A.6.3.3(6) Emergency shoring operations for urban search and rescue incidents provide a safe and efficient atmosphere while conducting search and rescue operations for trapped victims. The intent is to provide a relatively safe and reduced–risk environment for both the victim and the trained rescue forces. The process includes stabilizing adjacent structures or objects that might have been affected by the initial incident. Figure A.6.3.3(6)(a) through Figure A.6.3.3(6)(j) depict operations–level shores that rescuers working at the operations level should be able to construct and properly install. They include T shore, double T shore, two-post vertical shore, multi-post vertical shore, door and window shore, horizontal shore, flying raker shore, split sole raker shore, solid sole raker shore, and box cribbing stacks.

A.6.4.3(3) Large disaster environments might have much in common with a wilderness environment. Thus, where wide area searches are conducted in this type of environment, the use of some of the wilderness search and rescue requirements of this standard can promote rescuer safety and effectiveness. [*See also A.6.3.3(3).*]

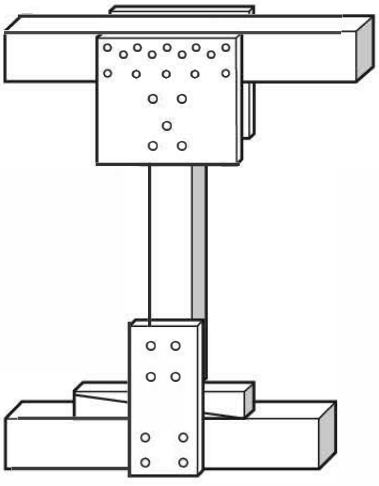

FIGURE A.6.3.3(6)(a) T Shore.

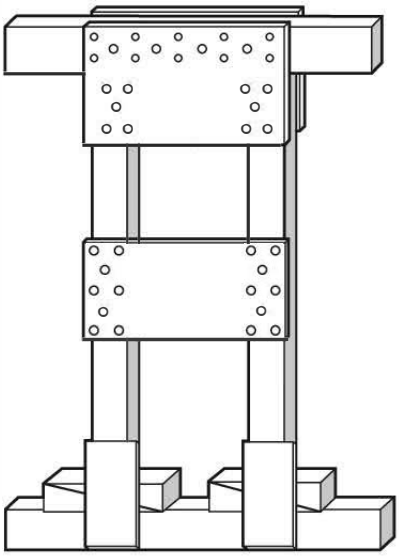

FIGURE A.6.3.3(6)(b) Double T Shore.

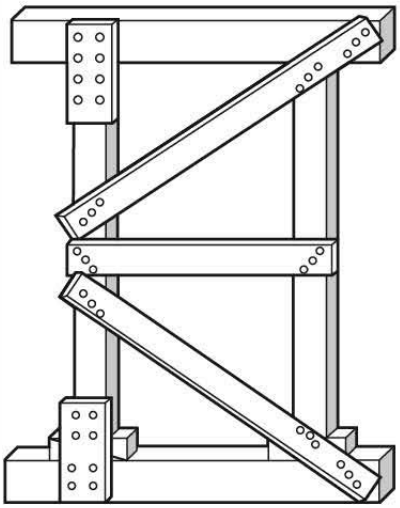

FIGURE A.6.3.3(6)(c) Two-Post Vertical Shore.

A.6.4.3(4) Generally, locating and extricating victims in concrete tilt-up, reinforced concrete, and steel construction is more complicated than in light-frame, ordinary construction or reinforced and unreinforced masonry construction. As structural components, materials, and weights increase, the ability to breach, stabilize, and operate within such a structural collapse becomes more hazardous, complicated, and time-consuming.

The overall ability of the AHJ to function safely and effectively is greatly dependent upon the prompt availability of appropriate tools, equipment, and supplies to accomplish operations. In concrete tilt-up, reinforced concrete, and steel construction, organizations should understand that the tools that are needed change depending on the type of structure involved. Structural collapse incidents involving these catego-

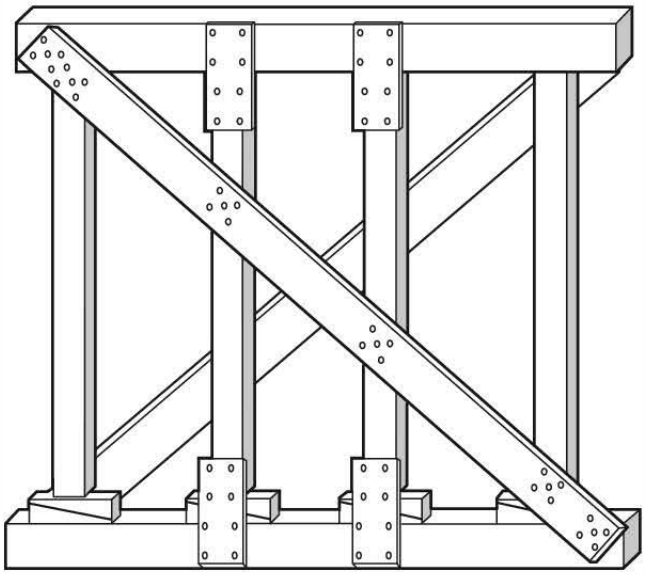

FIGURE A.6.3.3(6)(d) Multi-Post Vertical Shore.

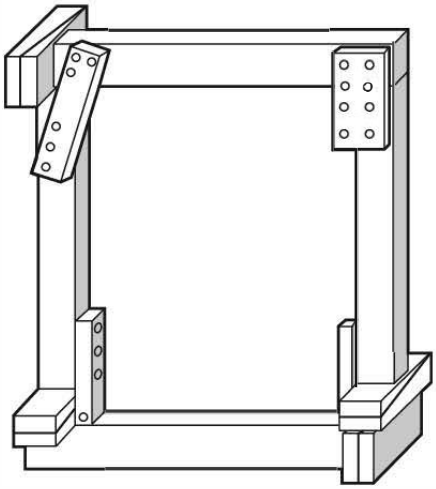

FIGURE A.6.3.3(6)(e) Door and Window Shore.

ries of construction necessitate the use of tools and equipment specifically designed for these materials, including, but not limited to, the following:

(1) Masonry saws and blades
(2) Rotary hammers and breakers
(3) Rescue air bags
(4) Dump trucks and front-end loaders
(5) Concrete saws and blades
(6) Pneumatic and hydraulic drills, hammers, and breakers
(7) Cranes
(8) Burning and cutting equipment such as oxyacetylene and exothermic or plasma cutters
(9) Bolting and anchoring systems

Power tools (e.g., air bags, hydraulic spreaders and rams, and power saws) and training necessary to breach, cut, bore, and lift structural components displaced by partial or total structural collapse should be provided.

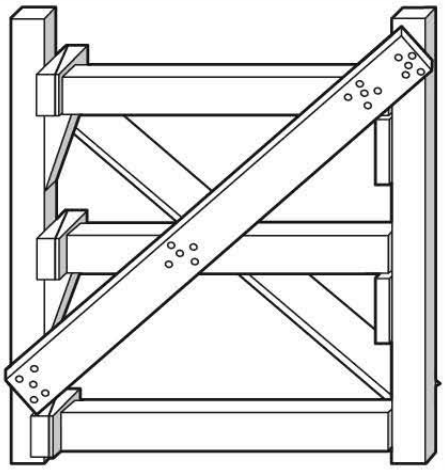

FIGURE A.6.3.3(6)(f) Horizontal Shore.

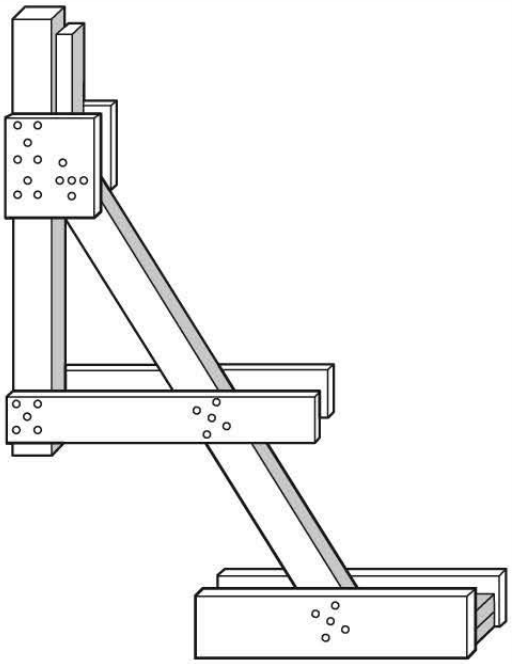

FIGURE A.6.3.3(6)(g) Flying Raker Shore.

A.6.4.3(5) See A.6.3.3(5).

A.6.4.3(6) Emergency shoring operations for urban search and rescue incidents provide a safe and efficient atmosphere while conducting search and rescue operations for trapped victims. The intent is to provide a relatively safe and reduced-risk environment for both the victim and the trained rescue force. The process includes stabilizing adjacent structures or objects that might have been affected by the initial incident. Figure A.6.4.3(6)(a) through Figure A.6.4.3(6)(f) depict technician-level shores that rescuers working at the technician level should be able to construct and properly install. They include all operations-level shores as well as laced post shore, plywood laced post shore, sloped floor shores (Type 2 and Type 3), double and triple raker shores, flying shore, and combination shores designed by a structural engineer.

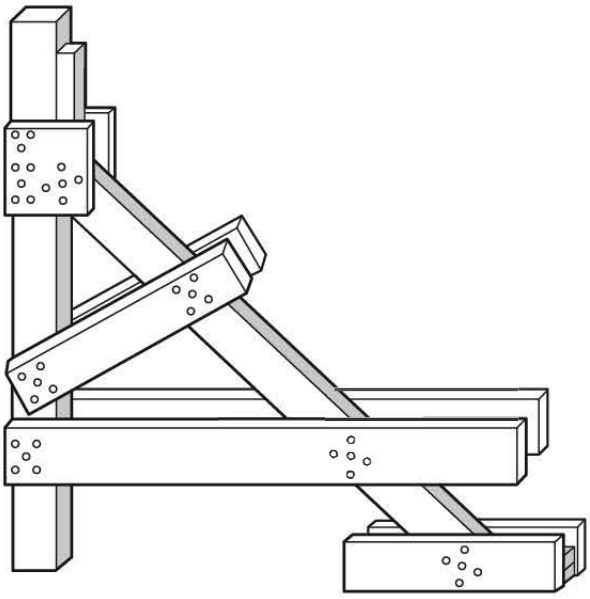

FIGURE A.6.3.3(6)(h) Split Sole Raker Shore.

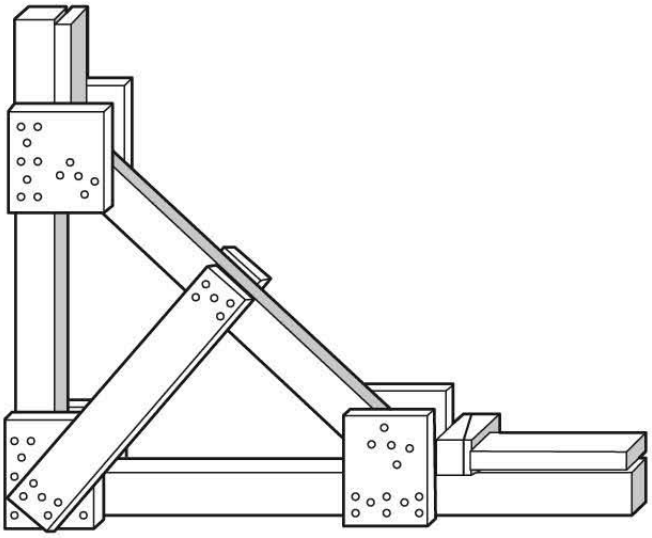

FIGURE A.6.3.3(6)(i) Solid Sole Raker Shore.

A.7.1.2 While much of this chapter applies to confined space rescue in industrial settings, it is intended for all incidents involving confined spaces as defined within this standard.

A.7.1.3 The term *timely* is based on many factors such as perceived danger of the original entry (e.g., possible supplied breathing air required), distance to definitive medical care, capabilities of responding emergency medical services, and so forth. In trauma-related injuries, the "golden hour" principle can be used to determine how quickly the rescue service should be able to respond to deliver the patient to the appropriate treatment facility within an hour of onset of injuries. The rescue service should have a goal of responding to these emergencies within 15 minutes of the time they receive notification.

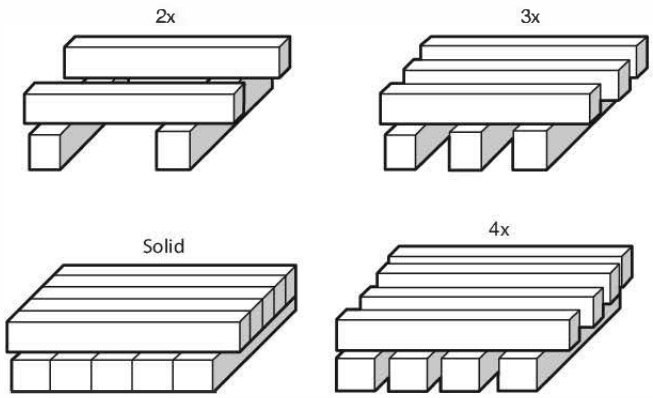

FIGURE A.6.3.3(6)(j) Box Cribbing.

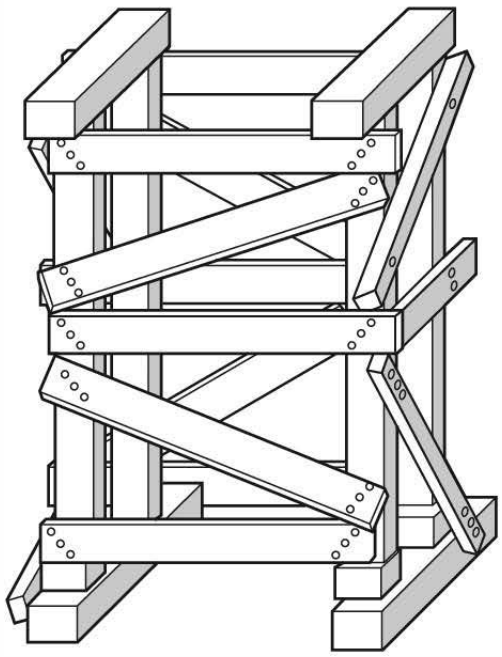

FIGURE A.6.4.3(6)(a) Laced Post Shore.

A.7.2.4(3) Hazards can include, but are not limited to, the following:

(1) Hazardous atmospheres
(2) Hazardous chemicals
(3) Temperature extremes

Some methods of recognition and assessment of hazards associated with confined spaces include, but are not limited to, the following:

(1) Assessment of the perimeter surrounding the confined space incident to determine the presence of or potential for a hazardous condition that could pose a risk to rescuers during approach
(2) Recognition of the need for decontamination of a patient or responder who might have been exposed to a hazardous material as per NFPA 472, NFPA 473, and OSHA regulations in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)

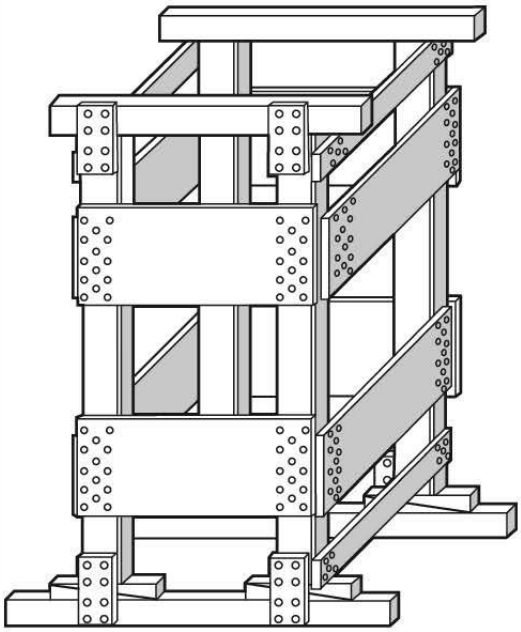

FIGURE A.6.4.3(6)(b) Plywood Laced Post Shore.

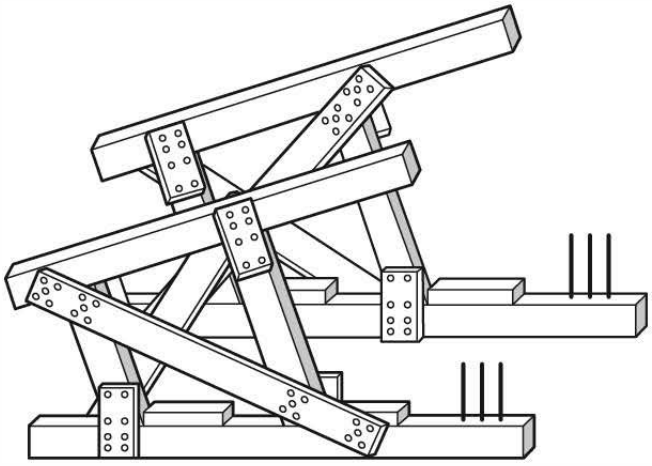

FIGURE A.6.4.3(6)(c) Sloped Floor Shore Type 2.

(3) Recognition of the need for a confined space rescue service or additional resources when nonentry retrieval is not possible
(4) Notification of the designated rescue service and other resources necessary for initiation of confined space rescue
(5) Recognition of hazardous atmospheres or materials through visual assessment and information received from on-site personnel

A.7.2.4(4) The term *confined space* as defined within this standard is synonymous with the term *permit-required confined space* or *permit space* used by many U.S. federally regulated agencies.

A.7.2.4(5) Retrieval includes the operation of common nonentry retrieval systems. Examples include simple winch and block devices used in conjunction with tripods, quadpods, or other manufactured portable anchor systems. A nonentry

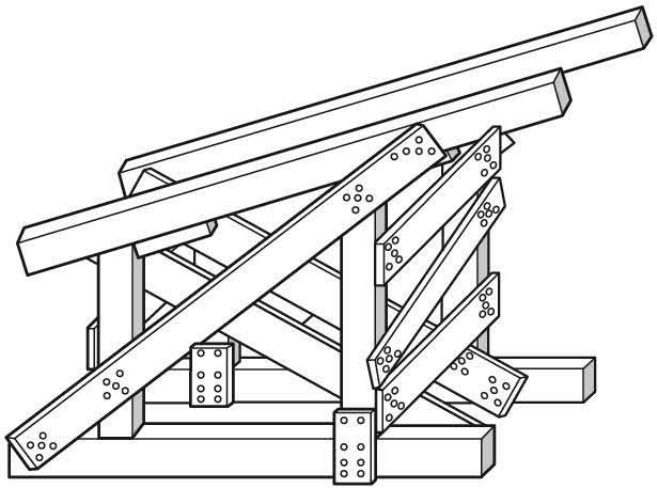

FIGURE A.6.4.3(6)(d) Sloped Floor Shore Type 3.

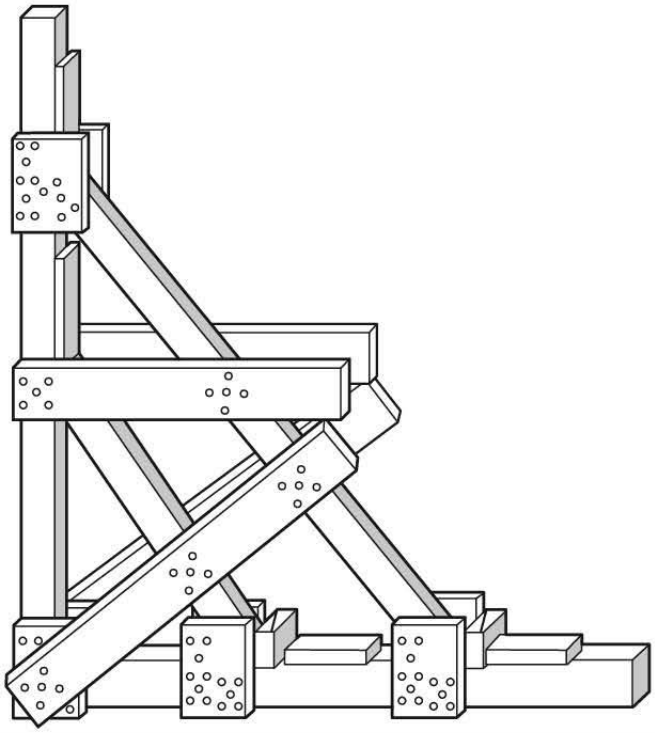

FIGURE A.6.4.3(6)(e) Double Raker Shore.

retrieval can simply involve operating the crank on a winch/tripod system where anchors and protection systems are already in place.

A.7.2.4(6) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources. In addition, the system includes procurement of on-site information resources such as witnesses, industrial entry supervisors, industrial facility managers, engineers, or other responsible persons. Printed on-site information resources available at

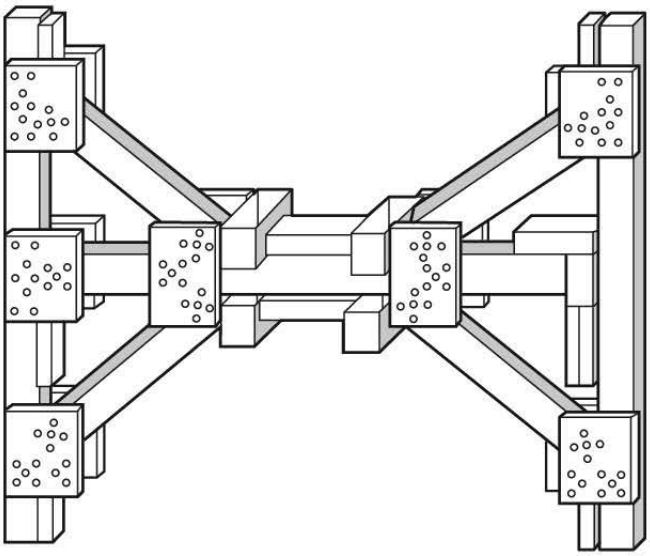

FIGURE A.6.4.3(6)(f) Flying Shore.

many U.S. federally regulated industrial facilities can include, but are not limited to, the following:

(1) Entry permit
(2) Chemical information documents (i.e., SDS)
(3) Other site work permits

A.7.2.4(7) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This process might include management of all civilian and nonemergency personnel and establishment of operational zones and site security. The organization should also assure through written standard operating guidelines that the scene is rendered safe at the termination of the incident.

A.7.3.2.1 In general, confined space rescue teams are composed of no less than six members to perform all the required functions listed. However, the size and capability of a team required to perform a specific rescue will depend on many factors, including the condition of the patient, the size and shape of the space, size of the access opening, and the hazards present. The positions described in 7.3.2.1(1) through 7.3.2.1(4) describe the minimum number of exclusive roles that must be filled to perform an entry-type rescue. Many rescues will require additional functions such as ventilation, rope rescue support, or communication that will require additional trained resources. Pre-incident planning of representative spaces is a key element in determining the size and capabilities of the team.

A.7.3.2.1(1) Entry team size will be driven by the size of the space and the degree of difficulty of the rescue operation. While at the operations level the entry team size should be no less than two members, some spaces requiring technician-level resources could be only large enough to accommodate a single rescuer. Some incidents might involve large spaces or complex rescue operations that will require several rescuers to enter the space.

A.7.3.2.1(2) The intent of the backup team is to quickly and effectively remove an incapacitated rescuer who is unable to perform self-rescue. In general, this requires no less than two members immediately available to enter the space equipped with the same or greater level of PPE as the entry team. The size and capability of the team should be driven by the specific conditions encountered and the scope of the rescue operation.

A.7.3.2.2(1) The intent of 7.3.2.2(1) is to limit the danger of entanglement.

A.7.3.2.2(2) The intent of 7.3.2.2(2) is to ensure that the attendant can maintain direct observation of the entrants at all times, making recognition of problems more rapid.

A.7.3.2.2(3) The intent of 7.3.2.2(3) is to allow for easier retrieval of rescue entrants should this become necessary and to provide for passage through the opening without removal of necessary PPE, including fresh-air breathing apparatus.

A.7.3.2.2(4) The intent of 7.3.2.2(4) is to allow a "buddy system" to be employed, providing potentially faster response to a problem with one of the rescue entrants.

A.7.3.2.2(5) The intent of 7.3.2.2(5) is to ensure that hazards to rescuers in organizations at this level are kept to an absolute minimum.

A.7.3.5 The requirement in 7.3.5 provides for training necessary to gain proficiency for every size, type, and configuration of confined space to which an agency must respond. This means training once every 12 months for each type of space to which the agency must respond. Similar spaces can be grouped, where applicable, to provide for efficient use of training time. For example, for vessels located in many areas of a jurisdiction that are similar with respect to accessibility and internal configuration but with different size openings, practice need only be with a variety of openings to satisfy this requirement. It is not necessary or practical to practice on literally every space; rather it should be ensured that the response agency is proficient enough to handle emergencies in the spaces within its jurisdiction.

A.7.3.6(1) The assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Hazards such as engulfment potential, environmental hazards (e.g., chemical, atmospheric, temperature), harmful forms of energy (e.g., electrical, mechanical, movement due to gravity, hydraulic), configuration hazards (e.g., diverging walls, entrapment, obstructions, trip/fall hazards), and so forth
(2) Risk/benefit analysis (body recovery versus rescue)
(3) Available/necessary additional resources
(4) Establishment of control zones
(5) Magnitude of the hazard and isolation procedures
(6) Effectiveness of the nonentry or qualifying entry–type rescue
(7) Overall safety of rescue operations
(8) Level of rescue response (appropriate for the type of rescue being attempted)
(9) Current and projected status of the planned response
(10) Personnel accountability

A site safety plan can also provide useful information for consideration during size-up and should include the following:

(1) Rescue team notification
(2) Acceptable entry conditions for rescue
(3) Hazard identification
(4) Risk assessment of hazards
(5) Site map

(6) Hazard abatement (including control zones, ventilation, and lockout/tagout procedures)
(7) Use of buddy system (where applicable)
(8) Communications (e.g., site, rescue attendant to rescue entrant)
(9) Command post
(10) Incident management organizational chart
(11) Standard operating guidelines
(12) Safe work practices
(13) Medical assistance
(14) Pre-entry safety briefings
(15) Pre- and postentry physicals (if indicated)

A.7.3.6(2) See Annex G.

A.7.3.6(3) The AHJ should address the possibility of members of the organization having physical and/or psychological disorders (e.g., physical disabilities, fear of heights, fear of enclosed spaces) that could impair their ability to perform rescue in confined spaces.

A.7.3.6(4) Roles, functions, and responsibilities for these team positions should be consistent with the organization's standard operating guidelines for confined space rescue.

A.7.3.6(5) Personnel meeting the requirements of NFPA 472 should perform the monitoring procedures even if such personnel are not part of the rescue team. Monitoring the atmosphere can include the following considerations:

(1) Acceptable limits for oxygen concentration in air should be between 19.5 percent and 23.5 percent. An oxygen-enriched atmosphere is considered to be greater than 23.5 percent and poses a flammability hazard. An oxygen-deficient atmosphere is considered to be lower than 19.5 percent and can lead to asphyxiation without fresh-air breathing apparatus.
(2) Flammability is measured as a percentage of a material's lower explosive limit (LEL) or lower flammable limit (LFL). Rescuers should not enter confined spaces containing atmospheres greater than 10 percent of a material's LEL regardless of the PPE worn. There is no adequate protection for an explosion within a confined space.
(3) Acceptable toxicity levels are specific to the hazardous material involved, and chemical properties should be assessed to determine the level of the hazard for a given environment and time frame.

The confined space rescue team at the operations level should have available resources capable of understanding the assessment tools necessary for analysis and identification of hazardous conditions within confined spaces and interpretation of that data. This capability should include at least the following:

(1) Identification of the hazards found within confined spaces and understanding how those hazards influence victim viability and rescue/recovery operations
(2) Selection and use of monitoring equipment to assess the following hazards:
    (a) Oxygen-deficient atmospheres
    (b) Oxygen-enriched atmospheres
    (c) Flammable environments
    (d) Toxic exposures
    (e) Radioactive exposures
    (f) Corrosive exposures
(3) Understanding of the limiting factors associated with the selection and use of the atmospheric and chemical monitoring equipment provided by the AHJ for confined space emergencies. The factors determined by this equipment include, but are not limited to, calibration, proper operation, response time, detection range, relative response, sensitivity, selectivity, inherent safety, environmental conditions, and the nature of the hazard. This equipment could include, but is not limited to, the following:
    (a) Calorimetric tubes
    (b) Oxygen concentration monitor (continuous reading, remote sampling)
    (c) Combustible gas monitor (continuous reading, remote sampling)
    (d) Specific toxicity monitor (continuous reading, remote sampling)
    (e) Multigas atmospheric monitors (continuous reading, remote sampling)
    (f) Passive dosimeter
    (g) pH papers, pH meters, and pH strips
    (h) Radiation detection instruments
(4) Utilization and evaluation of reference terms and resources to include, but not be limited to, the following:
    (a) Lethal concentration-50 (LC-50)
    (b) Lethal dose-50 (LD-50)
    (c) Permissible exposure limit (PEL)
    (d) Threshold limit value (TLV)
    (e) Threshold limit value — short-term exposure limit (TLV-STEL)
    (f) Threshold limit value — time-weighted average (TLV-TWA)
    (g) Immediately dangerous to life and health (IDLH)
    (h) Chemical information documents (i.e., SDS)
    (i) Reference manuals
    (j) Computerized reference databases
    (k) Technical information centers
    (l) Technical information specialists
    (m) Monitoring equipment

A.7.3.6(6) The intent of 7.3.6(6) is to restrict entries made by operations-level organizations to those that would absolutely minimize risk to rescue entrants.

A.7.3.6(7) Packaging devices that can be used in confined spaces include, but are not limited to, the following:

(1) Full spine immobilization devices
(2) Short spine immobilization devices
(3) Cervical spine immobilization devices
(4) Litters
(5) Prefabricated full-body harnesses
(6) Tied full-body harnesses
(7) Wrist loops (wristlets)

A.7.3.6(8) Organizations at the operations level are expected to safely apply lowering and raising systems (rope- or nonrope-based) as appropriate during confined space emergencies. These applications can involve the use of rope rescue systems in the high-angle environment to both lower rescuers into and remove rescuers and victims from confined spaces. The determination of what systems are most appropriate to accomplish these tasks should be dictated by the circumstances surrounding the incident.

A.7.4.3(2) See Annex G.

A.7.4.3(3) See Annex G.

A.8.1 It is the intent of this provision that the AHJ, as part of the hazard identification and risk assessment, identify the types of vehicles within its response area. These types can include, but are not limited to, cars, trucks, buses, trains, mass transit systems, aircraft, and watercraft. The AHJ should develop procedures and provide training to personnel that are commensurate with the potential for search and rescue situations involving the above-mentioned vehicles.

A.8.2.3(2) See A.4.2.5.

A.8.2.3(3) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.8.2.3(4) These procedures should include the process of achieving and maintaining control of the site and the perimeter. They might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.8.2.3(5) General hazards associated with operations at vehicle search and rescue incidents can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) Fire or explosion
(2) *Utilities.* Control of the utilities in and around a vehicle search and rescue incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:
    (a) Electrical services (primary and secondary)
    (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
    (c) Water
    (d) Sanitary systems
    (e) Communications
    (f) Secondary service systems (such as compressed, medical, or industrial gases)
(3) *Hazardous Materials.* Vehicle rescue incidents might include various materials that, when released during an incident, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.
(4) *Personal Hazards.* At the site of any vehicle search and rescue incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, cuts, abrasions, punctures, impalement, and so forth.
(5) *Movement of Vehicle(s).* Uncontrolled movement of vehicle(s) can cause extremely hazardous and potentially fatal situations. Responding personnel should be familiar with and trained in techniques for stabilizing and removing the potential for movement of vehicle(s).
(6) *Release of High-Pressure Systems.* Vehicles often include high-pressure systems (e.g., hydraulic, pneumatic) that can fail without warning. Such failure can cause extremely hazardous conditions, injury, and death of victims and responders. The AHJ should provide members with training in the recognition of potential high-pressure system hazards, the determination of an existing hazard, and the methods used to contain, confine, or divert such hazards to conduct operations safely and effectively.
(7) *Blood and Body Substances.* Vehicle incidents typically result in injury to occupants of the vehicle or those in the vicinity. The AHJ should train its members on procedures and equipment used to protect the responder from communicable diseases that are known to be transmitted through blood and other body substances. This equipment usually includes the use of fluid impervious gloves, goggles, masks, and gowns/coveralls.
(8) *Hybrid, Electric and Alternative Propulsion Systems.* Vehicles that use power sources separate from and in addition to conventional internal combustion engines can present hazards to untrained responders even if the vehicle is not compromised. AHJ should provide training to its members on recognition of these propulsion systems and how to safely operate in and around them.
(9) *Other Hazards.* There are numerous other hazards associated with vehicle search and rescue incidents. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.

A.8.3.3 This is intended to represent vehicles the agency and its members will be routinely exposed to during emergency work and whose configurations, hazards and systems are familiar and commonplace. For nearly every AHJ, this is intended to reflect the common passenger car or light truck. However, some specialized agencies such as industrial fire brigades or airport fire departments routinely respond to incidents involving other types of vehicles, depending on their location or specific mission.

A.8.3.4(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident
(2) Risk/benefit analysis (body recovery versus rescue)
(3) Number and size of vehicles affected
(4) Integrity and stability of vehicles affected
(5) Number of known or potential victims
(6) Access to the scene
(7) Hazards such as disrupted or exposed utilities, standing or flowing water, mechanical hazards, hazardous materials, electrical hazards, and explosives
(8) Exposure to traffic
(9) Environmental factors
(10) Available versus necessary resources

A.8.3.4(3) The search and rescue area is that area immediately surrounding [within approximately a 20 ft (6 m) radius of] the vehicle. Making the search and rescue area safe includes, but is not limited to, the following actions (however, specific actions should be based on the vehicle and the specific situation):

(1) Establishing operational zones (i.e., hot, warm, cold) and site security
(2) Utilizing specific techniques and tools (including cribbing, chocks, and wedges) to stabilize the vehicle
(3) Utilizing specific techniques and tools to control the hazards presented by the vehicle, its energy source, propulsion system, or other intrinsic sources of stored energy
(4) Making the search and rescue area (i.e., hot zone) safe for entry
(5) Safely undertaking disentanglement and extrication operations using hand tools
(6) Ventilating the search and rescue area and monitoring its atmosphere when necessary
(7) Supporting any unbroken utilities
(8) Providing protective equipment for any victims, if possible, when necessary
(9) Prohibiting entry into an unsafe vehicle search and rescue area
(10) Preventing the touching or operating of equipment involved until its safety has been established

"Control" is intended to include strategies that actively identify the hazard to those in the area and to exclude responders from the area of influence it presents.

A.8.3.4(4) The use of nonsparking tools should be considered where a flammable atmosphere exists.

A.8.3.4(7) See A.8.3.3.

A.8.3.4(8) To ensure a safe disentanglement or extrication operation, the AHJ should provide training on the following topics:

(1) Types of passenger restraint systems, especially supplemental restraint systems such as airbags
(2) Frame and construction features of vehicles
(3) Types of suspension systems in vehicles
(4) Types and classification of impacts
(5) Categories of mechanical injury
(6) Various stabilization techniques
(7) Center of gravity and its relationship to rollover
(8) Use of cribbing and chocks
(9) Building a crib box
(10) Types and examples of levers for mechanical advantage
(11) Proper and effective use of hand tools, including a hammer, pry bar, hacksaw, glass punch, Halligan, knife or belt cutter, cable cutter, and come-along
(12) Disentanglement through primary access points
(13) Patient packaging prior to removal from a vehicle
(14) Protection of the victim during extrication or disentanglement operations
(15) Proper and effective use of power tools such as hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools
(16) Alternative propulsion systems that use power sources other than conventional gas or diesel internal combustion engines (*See also A.8.3.3.*)

A.8.3.4(9) These procedures refer to the mitigation and management of the hazards identified in A.8.2.3(5). See A.8.3.3 for the types of vehicles covered. Responders at the operations level are not expected to manage exotic, unfamiliar or multiple concurrent hazards. Examples would include the following:

(1) Unstable vehicles in unconventional positions, such as those on their top or side
(2) Vehicles in trenches or excavations
(3) Vehicles located where rope rescue skills are required for access

A.8.4.2(2) To ensure that disentanglement or extrication from large, heavy vehicles is performed safely, the AHJ should provide training on the following topics:

(1) Frame and construction features of heavy, large vehicles
(2) Use and components of a search and rescue chain assembly
(3) Pneumatic high-, medium-, and low-pressure lifting bags
(4) Use, care, and maintenance of wire rope and its associated equipment
(5) Large and heavy object weight estimation
(6) Steps necessary to lift or move large objects
(7) Use of cribbing and chocks with large and heavy objects
(8) Use of commercial heavy wreckers and recovery services to assist at incidents involving large transportation vehicles
(9) Use, care, and maintenance of both manual and power winches
(10) Types and examples of lifting devices that use mechanical advantage principles
(11) Proper and effective use of power tools, including hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools
(12) Disentanglement through both primary and secondary access points through the use of available power tools
(13) Protection of the victim during this type of extrication or disentanglement operation
(14) Identification and use of various sling configurations

A.8.4.2(3) "Unusual" situations include, but are not limited to, extrication or disentanglement operations at incidents involving cars on their tops, cars on their sides, and cars on top of other cars, trucks, and large commercial vehicles.

"Advanced stabilization" includes techniques using chains, cables, jack devices, and cribbing or shoring to stabilize vehicles of any size.

A.8.4.2(4) "Specialized search and rescue equipment" can include, but is not limited to, hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools immediately available and in use by the organization. Power tools should be provided and can include, but are not limited to, air bags, hydraulic spreaders and rams, hand tools, and other power tools and training necessary to remove, cut, and move components displaced at a vehicle search and rescue incident.

A.9.1 See Annex J, Animal Rescue.

A.10.1.1 What is and is not considered "wilderness" can change with any particular combination of weather, terrain, and hazards that make it difficult to locate, access, and/or evacuate the subject.

A.10.2.3(2) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

Wilderness search and rescue responses often involve multiple organizations in the initial response when the subject's location, the terrain involved, and the environmental conditions

are unknown, unconfirmed, or different than initially reported. Wilderness incidents are also resource intensive. Due to the number of resources responding, the response organization should be trained and equipped to initiate an incident management system while en route rather than waiting until personnel arrive.

A.10.2.3(3) Training should address the process of achieving and maintaining control of all ingress and egress of the trailhead or road head. This control might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.10.2.3(4) General hazards associated with search and rescue operations in the wilderness can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards and, to help provide for their safety, ensure that members have the ability to recognize potential hazards that they can encounter.

(1) *Personal Hazards.* In the wilderness environment, there are many dangers that pose personal injury and physiological hazards to responders. Personnel should be made aware of hazards including, but not limited to, blisters, scrapes, scratches, falls, blows, bruises, dehydration, heat and cold-related injuries, and so forth.
(2) *Environmental Hazards.* Depending on the specific environment, there are many dangers that pose hazards to responders. Personnel should be made aware of hazards including, but not limited to, insect bites and stings, poisonous plants, exposure injuries (cold and heat), snow blindness, altitude illness, lightning, sunburn, dangerous wildlife, and so forth.
(3) *Terrain Hazards.* Specific features in an environment can pose hazards to responders. Personnel should be made aware of hazards including, but not limited to, cliffs, avalanches, standing water (e.g., ponds, lakes), flat ice (e.g., ponds, lakes), moving water (e.g., rivers, streams), caves, mines, wells, high winds, snow (blowing and fallen), coastal white water surf, and so forth.
(4) *Man-Made Hazards.* Humans, whether intentionally or accidentally, can also cause unsafe conditions in the wilderness. Personnel should be made aware of hazards including, but not limited to, booby-trapped stills and labs (covert ethanol and drug production), hazardous materials dumps, trained attack dogs (protecting drug labs), remotely managed waterways, and so forth.

A.10.2.3(6) Conventional emergency response PPE and other equipment (especially fire-related equipment) are often inappropriate for use in a wilderness setting. For instance, fire helmets and boots can increase one's potential for injury in the wilderness. Conventional emergency response skills such as using a sphygmomanometer and using an ambulance cot have very little application in the wilderness. Therefore, such skills and equipment will require modification to achieve the rescuer's desired goals in the wilderness.

A.10.2.3(7) Documents for the collection and recording of information can include the following:

(1) Information regarding the lost or missing person(s)
(2) Information needed to determine search urgency
(3) Information required by the AHJ
(4) Information required by the IMS
(5) Information required to identify a subject's track (i.e., footprint)
(6) Information for development of the search and rescue response strategy

A.10.2.3(8) Isolation includes keeping the reporting party readily available for interviewers and isolated from media and the incident operations, as well as isolated from one another, in the case of multiple reporting parties.

A.10.3.2 In some cases, where minimum exposure to wilderness hazards exists, it can be appropriate for the AHJ to establish SOPs that permit an operations-level organization to conduct certain search and rescue operations without supervision of a technician-level organization.

A.10.3.4(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident, including whether it is a search, rescue, or body recovery
(2) Assessment of time required
(3) Assessment of staffing needs
(4) Specific environmental factors involved
(5) Integrity and stability of the environment involved
(6) Number of known/potential victims
(7) Environmental conditions (current and forecast)
(8) Urgency (based on the type of known/potential victims)
(9) Available/necessary resources

A.10.3.4(2) Resources can include but are not limited to the following:

(1) Search dogs
(2) Trackers
(3) Aircraft
(4) Ground/air search specialists
(5) Rope rescue specialists
(6) Water search and rescue specialists
(7) Trench rescue specialists
(8) Vehicle/machinery rescue specialists
(9) Collapsed building search and/or rescue specialists
(10) Emergency incident management (overhead) teams
(11) Avalanche rescue specialists
(12) Cave rescue specialists
(13) Mine rescue specialists
(14) Other technical search and/or rescue providers and managers

A.10.3.4(4) Body management refers to the skills and knowledge involved in maintaining personal nutrition, hydration, rest, and other physiological requirements of the human body.

A.10.3.4(7) Personal support equipment should include that which is necessary to address the following needs, or potential needs, of a responder in a wilderness setting:

(1) Personal medical (first aid) supplies
(2) Additional clothing appropriate for anticipated environment/weather
(3) Fluids and food appropriate for mission duration
(4) Personal safety and comfort gear (e.g., flashlight, sunglasses, sunscreen)
(5) Navigation tools (e.g., compass, map)
(6) General marking and documentation tools (e.g., flagging tape, paper/pencil)
(7) Improvisational tools (e.g., wire, twine, leaf bag, safety pin)
(8) Emergency shelter, bivouac, and/or body protection
(9) Communications including emergency back-up (e.g., whistle, radio, flare)

(10) Pack to carry and protect contents (e.g., belt pack, rucksack)

A.10.3.4(11) The AHJ should establish procedures for negotiating and/or avoiding conditions and hazards specific to the wilderness environments and terrains in which rescuers can become involved. It is likely that some conditions and/or situations will exceed the capability of the organization. In such situations, additional, more experienced, specialized, or highly trained resources should be procured. *[See also A.10.3.4(16).]*

A.10.3.4(12) The National Search and Rescue Committee recommends using the georeferencing (coordinate) systems shown in Table A.10.3.4(12).

A.10.3.4(16) Knowledge and skills involved in supporting and participating in a search should include, but are not limited to, the following:

(1) Hasty, low coverage, and high coverage search techniques
(2) Principles of confinement of the search area
(3) Principles and importance of clue awareness
(4) Basic search theory application and terminology
(5) Principles of lost person behavior
(6) Procedures for serving as an air observer (e.g., searching from an aircraft)
(7) Procedures for handling, processing, and documenting evidence

A.10.3.4(21) Responders should be able to assess limitations in accessing and/or evacuating the subject based on the following:

(1) Individual and team expertise
(2) Qualified personnel available
(3) Ability to communicate from the subject's location
(4) Anticipated staffing and time

A.10.4.2 See Mountain Rescue Association Policies, POLICY 105 Personnel Guidelines.

A.10.4.6(4) Technician-level responders should be adept and experienced at awareness and operations level skills. Teams operating at the technician level should have the capability to address any potential operation that falls within their jurisdiction. To accomplish this, responders at the technician level should be personally adept at wilderness skills, travel, and operations in the wilderness setting.

A.10.4.6(5) Such an operational plan should be based on the hazard identification and risk assessment performed according to Section 4.2, available resources, environmental influences and conditions, and the urgency of the situation. Specifically with regard to a search, the implemented plan should involve planning and search management techniques including, but not necessarily limited to, the following:

(1) Determining the urgency of the search
(2) Developing a lost subject profile
(3) Establishing the search area and correctly dividing it into regions and segments as necessary
(4) Conducting an appropriate investigation and interviews
(5) Applying the mathematical concept of probability and search theory
(6) Designing, developing, implementing and monitoring appropriate search strategy and tactics
(7) Establishing and managing appropriate support camps
(8) Briefing and debriefing of operational personnel properly and thoroughly
(9) Considering suspension of the search when appropriate
(10) Demobilizing personnel and facilities
(11) Documenting the incident properly

Table A.10.3.4(12) National SAR Committee's Georeferencing

Georeference System User	United States National Grid (USNG)	Latitude/Longitude DD-MM.mm [a]	GARS [b]
Land SAR Responder[c]	Primary	Secondary	N/A
Aeronautical SAR Responders[d]	Secondary	Primary	Tertiary
Air Space Deconfliction[e]	N/A	Primary	N/A
Land SAR Responder/ Aeronautical SAR Responder Interface[f]	Primary	Secondary	N/A
Incident Command:	Secondary	Primary	N/A
Air SAR Coordination	Primary	Secondary	N/A
Land SAR Coordination			
Area organization and accountability[g]	Secondary	Tertiary	Primary

[a]During CISAR operations (and to avoid confusion) latitude and longitude should be in one standard format: DD-MM.mm. If required, use up to 2 digits to the right of the decimal. If required, allow 3 digits in the degrees field for longitude (i.e., DDD-MM.mm). Do not use leading zeros to the left of the decimal for degrees or minutes that require fewer than the maximum number of possible digits to express their value. The minimum number of digits is always one, even if it is a zero. (Example: Recommended: 39°36.6'N 76°51.42'W; Not recommended: 39°36.600'N 076°51.420'W).
[b]GARS: Global Area Reference System.
[c]Land SAR responders use U.S. National Grid. However, a good familiarity with latitude and longitude is necessary to ensure effective interface between land and aeronautical SAR responders. (Note: Land SAR includes SAR on flooded terrain.)
[d]Aeronautical SAR responders will use latitude and longitude for CISAR response. However, aeronautical SAR responders that work directly with land SAR responders should understand the U.S. National Grid system for effective land SAR/aeronautical SAR interface.
[e]Air space deconfliction will *only* be implemented and managed using latitude and longitude.
[f]Aeronautical SAR responders working with land SAR responders have the primary responsibility of coordinating SAR using USNG. However both groups must become familiar with both georeference systems.
[g]Describes the requirement for providing situational awareness of CISAR operations geographically to federal, military, state, local, and tribal leadership. Provides for quick reference to send SAR resources closest to the incident.

A.10.4.7 Technician-level wilderness search and rescue incidents require a substantially greater demand on the personnel responding and can require the following:

(1) Endurance
(2) Capability to operate at high altitude
(3) Capability to operate in situations involving extreme elevation differences
(4) Equipment for extreme conditions
(5) Previous experience in the extreme wilderness environment

A.11.2.3(2) See A.5.2.2(2).

A.11.2.3(3) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.11.2.3(4) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This control might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.11.2.3(5) General hazards associated with search and rescue operations at trench and excavation collapses can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *Utilities.* Control of the utilities in and around a trench or excavation emergency is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:
    (a) Electrical services (primary and secondary)
    (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
    (c) Water/steam
    (d) Sanitary systems
    (e) Communications
    (f) Secondary service systems (such as compressed, medical, or industrial gases)
(2) *Hazardous Materials.* Excavations might include various materials unique to a site that, when released during a collapse, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.
(3) *Personal Hazards.* At the site of any trench or excavation collapse, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.
(4) *Confined Space.* All trench and many excavation collapses necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to members in confined space rescue.
(5) *Other Hazards.* There are numerous other hazards associated with trench and excavation collapses. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards to allow them to perform rescue operations safely and effectively.

The "general area" around a trench or excavation emergency is the entire area within 300 ft (92 m) (or more, as established by the incident commander). Making the general area safe includes, but is not necessarily limited to, the following:

(1) Controlling/limiting traffic and sources of vibration in the area, including shutting down all vehicles and equipment
(2) Controlling/limiting access to the area by unnecessary personnel
(3) Identifying hazards and removing and/or reducing their impact

A.11.2.3(6) The types of collapse normally encountered at an excavation or trench incident include the following:

(1) Spoil pile collapse — where the excavated earth piled on the side of the trench slides into the trench
(2) Shear wall collapse — where one side of the trench shears away from the wall of the trench
(3) Slough collapse — where a belowgrade section collapses, leaving the potential for the collapse of an overhanging ledge

The reasons and indicators of initial and secondary collapse of trenches and excavations are usually related to one or more of the following site characteristics:

(1) Unprotected trench (lack of protection systems)
(2) Static loads
(3) Standing water or water seeping into trench
(4) Intersecting trenches
(5) Vibrations (from vehicles, nearby roads, airports, etc.)
(6) Previously disturbed soil
(7) Exterior cracking of trench walls

A.11.2.3(7) Rapid, nonentry rescues include placing a ladder to allow a victim to perform a self-rescue or allowing uninjured persons in the trench to remove a victim.

A.11.2.3(8) As a rule of thumb, a cubic foot of soil weighs 100 lb, a cubic yard weighs 1.5 tons, and a cubic meter weighs 1600 kg. The weight and movement of soil alone can cause crush injuries, and the characteristics of the soil (e.g., wet, hard, sandy) will dictate how the soil will entrap (e.g., flow around, drown) a victim.

A.11.3.2 Severe environmental conditions include operations involving frozen soil, running soil (e.g., gravel, sand, liquid), severe weather (e.g., heavy rain, wind, or flooding), or night (dark) operations. Supplemental sheeting and shoring includes operations that involve the use of commercial sheeting/shoring systems and/or isolation devices, or cutting and placement of sheeting and shoring when greater than 2 ft (0.6 m) of shoring exists below the bottom of the strongback. Supplemental sheeting and shoring requires additional training beyond that of traditional sheeting and shoring. Traditional sheeting and shoring involves the use of 4 ft × 8 ft (1.2 m × 2.4 m) sheet panels with a strongback attachment supplemen-

ted by a variety of conventional shoring options such as hydraulic, pneumatic, and/or screw shores.

Commercial sheeting/shoring systems and devices include trench boxes, sheet piles, plate steel, and the like. Isolation devices include concrete pipes, concrete vaults, steel pipe, or anything that serves to separate the victim(s) from the surrounding soil.

A.11.3.3(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope, magnitude, and nature of the incident
(2) Location and number of victims
(3) Risk/benefit analysis (body recovery versus rescue)
(4) Exposure to traffic and sources of vibration
(5) Hazards such as disrupted or exposed utilities, standing or flowing water, secondary collapse, mechanical hazards, hazmat, and explosives
(6) Trench/excavation dimensions
(7) Access to the scene
(8) Environmental factors
(9) Available/necessary resources

A.11.3.3(3) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning should be provided to ensure the stability of such structures for the protection of employees. Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees should not be permitted except when one of the following occurs:

(1) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure.
(2) The excavation is in stable rock.
(3) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity.
(4) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees. Sidewalks, pavements, and appurtenant structures should not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

A.11.3.3(4) Procedures to identify probable victim locations include the following:

(1) Visualization of the victim
(2) Presence of drink cups or food containers, work tools, laser targets, buckets, grade poles, grease and brush, engineers' hubs, or anything that can indicate the victim's last probable physical location
(3) Information from bystanders
(4) End of pipe string
(5) Sounds in pipes
(6) "Cat" or tire tracks

A.11.3.3(5) The rescue area is that area immediately surrounding the trench and/or excavation site. Making the rescue area safe includes, but is not limited to, the following actions (however, specific actions should be based on both the type of collapse and the soil type):

(1) Utilizing sheeting and shoring to stabilize trench/excavation walls
(2) Making the trench/excavation safe for entry
(3) Safely undertaking disentanglement operations in the trench/excavation
(4) Placing ground pads at the lip of the trench/excavation
(5) Ventilating the trench and monitoring its atmosphere
(6) Dewatering
(7) Supporting any unbroken utilities
(8) Providing a helmet and goggles for a victim, if possible
(9) Prohibiting entry into an unsafe trench/excavation
(10) Preventing the touching or operating of heavy equipment until its safety has been established

The term *tabulated data* usually refers to the six tables found in Appendix C of 29 CFR 1926, Subpart P.

Traditional sheeting and shoring should not be used in situations that exceed the tabulated data for timber trench shoring presented in 29 CFR 1926, Subpart P. Also, these systems should not be used where they would be submerged in water.

A.11.3.3(6) In many parts of the United States, a one-call underground utility location service is available to contractors and residents who are preparing to excavate. By making one telephone call (usually a toll-free number), excavators can learn the location of all underground utility installations in the area of the planned excavation. This service quickly notifies all possible utility providers in the area who, in turn, either indicate that there is no utility in the area or have someone go to the site to mark the utilities. Such a service can be invaluable to emergency responders at the site of a trench or excavation emergency incident.

Where no one-call system exists, all utility companies that might have underground equipment at or near the excavation site must be notified so they can have a representative respond to mark underground utility locations.

A.11.3.3(7) See Annex H.

A.11.3.3(11) A ladder or engineered ramp can be required for entry or egress from a trench. For instance, 29 CFR 1926.651(c)(1)(v) requires, "A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees."

A.11.3.3(12) The pre-entry briefing should include, but not be limited to, information regarding the following:

(1) Tactical assignments with explicit instructions
(2) General hazards and safety instructions
(3) Communications protocols, procedures, and details
(4) Anticipated environmental concerns
(5) Time frames for operations
(6) Emergency procedures
(7) Specific equipment needs
(8) Debriefing procedures
(9) Anticipated logistical needs

A.11.3.3(13) Documentation for entry operations, as a minimum, should include the following:

(1) Development of some type of representation of IMS command structure
(2) Time of incident
(3) Total time of operation
(4) Environmental conditions

(5) Location of victim
(6) Creation of a tactical checklist that includes entry times, exit times, personal accountability reports, atmospheric readings, rehabilitation information, injuries sustained, and incident number

A.11.3.3(15) See Annex B for information on sloping and benching systems.

A.11.3.3(18) Procedures for disentanglement and removing the entrapment mechanism can include, but are not limited to, the following:

(1) Hand digging
(2) Lifting using air bags, pneumatic, or other mechanical advantage devices
(3) Suctioning
(4) Cutting using air knives, saws, or other power tools
(5) Dewatering
(6) Use of heavy equipment

Procedures and equipment involved in removal systems should comply with NFPA 1983.

Heavy or mechanical equipment and/or mechanical winches of any kind should not be used to physically lift, pull, or extricate victims from a trench. However, there can be circumstances when heavy equipment can be appropriate for accessing victims of trench and evacuation emergencies with the appropriate level of supervision and after careful consideration is given to the negative impact of such actions on the victim, including the effects of extreme superimposed loads and vibration adjacent to the trench. For example, heavy equipment might be used to dig an adjacent trench or hole for access, but the excessive loading and vibration of the area adjacent to the trench can cause a rapid deterioration in the condition of, and in the immediate environment surrounding, the victim. In any case, to best establish viable options and available capabilities, the advice of experienced and knowledgeable on-site personnel should be sought in order to make the best possible decisions.

A.11.4.2 See A.11.3.2.

A.11.4.3(2) Manufactured protection systems include trench boxes, rabbit boxes, "coffins," rigging and placement of sheet piles, rigging and placement of plate steel, or other similar commercial systems. *[See also 11.3.3(4).]*

A.11.4.3(3) Personnel meeting the requirements of NFPA 472 should perform the monitoring procedures even if such personnel are not part of the rescue team. Important information regarding these procedures include, but are not limited to, the following:

(1) Acceptable limits for oxygen concentration in air should be between 19.5 percent and 23.5 percent. An oxygen-enriched atmosphere is considered to be greater than 23.5 percent and poses a flammability hazard. An oxygen-deficient atmosphere is considered to be lower than 19.5 percent and can lead to asphyxiation without fresh-air breathing apparatus.
(2) Flammability is measured as a percentage of a material's lower explosive limit (LEL) or lower flammable limit (LFL). Rescuers should not enter confined spaces containing atmospheres greater than 10 percent of a material's LEL regardless of the PPE worn. There is no adequate protection for an explosion within a confined space.
(3) Acceptable toxicity levels are specific to the hazardous material involved, and chemical properties should be assessed to determine the level of the hazard for a given environment and time frame.

A.11.4.3(6) In certain soil and environmental conditions, it can be necessary to isolate the victim to disentangle him or her effectively. For instance, in sand, grain, pea gravel, coal slag, or any type of running product, it can be necessary to isolate the victim physically from the surrounding product to free him or her. Examples of isolation devices include concrete or steel pipe, corrugated pipe, concrete vaults, or other pre-engineered structures that sufficiently isolate and protect the victim.

A.12.1 It is the intent of this provision that the AHJ, as part of the hazard identification and risk assessment, identify the types of machinery within its response area. These types can include, but are not limited to, agriculture implements, industrial/construction or process machinery, and elevators/escalators. The AHJ should develop procedures and provide training to personnel that is commensurate with the potential for search and rescue situations involving the above-mentioned machinery.

A.12.2.3(2) See A.4.2.5.

A.12.2.3(3) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.12.2.3(4) These procedures should include the process of achieving and maintaining control of the site and the perimeter. They might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.12.2.3(5) General hazards associated with operations at machinery search and rescue incidents can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *Utilities.* Control of the utilities in and around a machinery search and rescue incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:
    (a) Electrical services (primary and secondary)
    (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
    (c) Water
    (d) Sanitary systems
    (e) Communications
    (f) Secondary service systems (such as compressed, medical, or industrial gases)
(2) *Hazardous Materials.* Machinery rescue incidents might include various materials that, when released during an incident, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.

(3) *Personal Hazards.* At the site of any machinery search and rescue incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure member's safety. Every member should be made aware of hazards such as trips, falls, blows, cuts, abrasions, punctures, impalement, and so forth.

(4) *Movement of Machinery.* Uncontrolled movement of machinery components can cause extremely hazardous and potentially fatal situations. Responding personnel should be familiar with and trained in techniques for stabilizing and removing the potential for movement of machinery components.

(5) *Release of High-Pressure Systems.* Machinery often includes high-pressure systems (e.g., hydraulic, pneumatic) that can fail without warning. Such failure can cause extremely hazardous conditions, injury, and death of victims and responders. The AHJ should provide members with training in the recognition of potential high-pressure system hazards, the determination of an existing hazard, and the methods used to contain, confine, or divert such hazards to conduct operations safely and effectively.

(6) *Other Hazards.* There are numerous other hazards associated with machinery search and rescue incidents. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.

A.12.3.4(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident
(2) Risk/benefit analysis (body recovery versus rescue)
(3) Size, construction, and material of machines affected
(4) Integrity and stability of machines affected
(5) Number of known or potential victims
(6) Access to the scene
(7) Hazards such as disrupted or exposed utilities, standing or flowing water, mechanical hazards, hazardous materials, electrical hazards, and fire and explosives
(8) Exposure to traffic
(9) Environmental factors
(10) Available versus necessary resources

A.12.3.4(3) The search and rescue area is that area immediately surrounding [within a 20 ft (6.10 m), or so, radius of] the machinery. Making the search and rescue area safe includes, but is not limited to, the following actions; however, specific actions should be based on the machinery type and specific situation:

(1) Establishing operational zones (i.e., hot, warm, cold) and site security
(2) Utilizing specific techniques and tools (including cribbing, chocks, and wedges) to stabilize the machinery
(3) Utilizing specific techniques and tools (i.e., lockout and tagout) to isolate the involved equipment
(4) Making the search and rescue area (i.e., hot zone) safe for entry
(5) Safely undertaking disentanglement and extrication operations
(6) Ventilating the search and rescue area and monitoring its atmosphere when necessary
(7) Supporting any unbroken utilities
(8) Providing protective equipment for any victims, if possible, when necessary
(9) Prohibiting entry into an unsafe vehicle or machinery search and rescue area
(10) Preventing the touching or operating of equipment or machinery involved until its safety has been established

A.12.3.4(4) The use of nonsparking tools should be considered where a flammable atmosphere exists.

A.12.3.4(8) To ensure a safe disentanglement or extrication operation, the AHJ should provide training on the following topics:

(1) Weight estimation
(2) Construction and materials of small machinery
(3) Identification of tension and compression forces
(4) Pneumatic high-, medium-, and low-pressure lifting bags
(5) Categories of mechanical injury
(6) Various ground-based stabilization techniques
(7) Center of gravity and its relationship to rollover
(8) Use of cribbing, chocks, and box cribbing
(9) Proper use of shackles and slings (including wire rope, chain, and synthetic rope of various types and styles)
(10) Types and examples of levers for mechanical advantage
(11) Proper and effective use of hand tools including a hammer, wrenches, sockets, screwdrivers, pry bars, saws, cable cutter, jacks, and come-along
(12) Disentanglement through primary access points
(13) Patient packaging prior to removal from a machine
(14) Protection of the victim during extrication or disentanglement operations
(15) Proper and effective use of power tools such as hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools
(16) Lockout/tagout of machinery
(17) Identification and use of various sling configurations
(18) The steps to lift and/or move an object

A.12.3.4(9) These procedures refer to the mitigation and management of the hazards identified in A.12.2.3(5).

A.12.3.4(11) Identifying the type of elevator systems found in buildings and determining the type of mechanical movement and the mechanical components can aid in minimizing the time required to extricate a conceivably trapped or entangle victim(s) from these devices.

A.12.4.2(2) To ensure that disentanglement or extrication from large machines is performed safely, in addition to those topics listed in A.12.3.4(1)(8) the AHJ should provide training on the following topics:

(1) Use of commercial heavy wreckers or crane services to assist at incidents involving large machinery
(2) Use, care, and maintenance of power winches
(3) Disentanglement through both primary and secondary access points through the use of available power tools

A.12.4.2(3) "Advanced stabilization" in this context includes the use of either of the following techniques on a machine of any size that has a shape or center of gravity that causes it to be inherently unstable:

(1) Establishment of an anchor over one's head
(2) Shoring

The intent here is to suggest that advanced stabilization is beyond the operations level and requires the tools and techniques of a technician-level team.

A.12.4.2(4) Power tools (e.g., air bags, hydraulic spreaders and rams, hand tools, and other power tools) and training necessary to remove, cut, and move components displaced at a machinery search and rescue incident should be provided. "Specialized rescue equipment" can include, but is not limited to, hydraulic, pneumatic, and electrical spreading, cutting, lifting, and ram-type tools immediately available and in use by the organization.

A.12.4.2(5) In elevator rescues, the typical safe order of victim removal is as follows:

(1) Car at or near the landing (within 18 in.), floor level through the normal entranceway
(2) Car within 3 ft of the landing, floor above through the normal entranceway
(3) Car stalled more than 3 ft from the landing (stalled above the landing), floor below through the normal entranceway (barricade opening to shaft)
(4) Car stalled more than 3 ft from the landing (top escape hatch removal), top escape hatch (must use fall arrest system)

A.12.4.3 This procedure will eliminate the hazard of a moving elevator and remove potential of a falling hazard. Adjacent elevator(s) in excess of five (5) floors might have large counterweights operating in the rear portion of the hoistway. Securing these remaining elevator(s) can aid in removing a potential source of energy that travels the opposite direction of the intended direction of the car.

A.12.4.4 Lockout/tagout procedures should be initiated including confirmation that all power sources have been secured in the off position.

A.13.2.3(2) Conventional emergency response PPE and other equipment (especially fire-related equipment) are often inappropriate for use in a cave setting. For instance, fire helmets and boots can increase one's potential for injury in the cave. Conventional emergency response skills such as using a sphygmomanometer and using an ambulance cot have very little application in the cave. Therefore, such skills and equipment will require modification to achieve the rescuer's desired goals in the cave. Caving is not simply confined space rescue on rope or in the dark. Typical travel times can be hours or even days to reach remote sections of caves. Rescuers should carry their own light with power source and spares, food, and other needs and be totally self-sufficient for at least 12 to 24 hours depending on the cave involved.

A.13.2.3(3) Organizations at the awareness and operational levels of cave search and rescue, that have caves in their operational area, should have a plan for contacting appropriate resources for cave rescue incidents. The National Cave Rescue Commission (NCRC) of the National Speleological Society provides a resource list of organizations with cave rescue capabilities, local caches of specialized cave rescue equipment, and local caving organizations. The NCRC provides training to both organizations and individuals in cave rescue.

A.13.2.3(5) General hazards associated with search and rescue operations in the cave can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards and, to help provide for their safety, ensure that members have the ability to recognize potential hazards that they could encounter. As many caves can be a mile or more from roadways, access to the cave entrance will bring the cave rescuer into many of the hazards also present in a wilderness response. In addition to those hazards, the following hazards will be encountered in-cave.

(1) *Personal Hazards.* In the cave environment, there are many dangers that pose personal injury and physiological hazards to responders. Personnel should be made aware of such hazards, including, but not limited to, blisters, scrapes, scratches, falls, blows, bruises, dehydration, and so forth.
(2) *Environmental Hazards.* Depending on the specific environment, there are many dangers that pose hazards to responders. Personnel should be made aware of such hazards, including, but not limited to, cold, chilling winds, water, exposure injuries (cold and heat), toxic plants, infectious organisms, and hazardous animal life.
(3) *Terrain Hazards.* Specific features in an environment can pose hazards to responders. Personnel should be made aware of such hazards, including, but not limited to, pits, sumps, waterfalls, standing water (e.g., ponds, lakes), moving water (e.g., rivers, streams), and so forth.
(4) *Man-Made Hazards.* Humans, whether intentionally or accidentally, can also cause unsafe conditions in the cave. Personnel should be made aware of such hazards, including, but not limited to, booby-trapped stills, labs (e.g., covert ethanol, drugs), gates, ladders, and inappropriate rigging.

A.13.2.3(6) One of the most important tasks for the first on-scene responders is to establish control of all cave entrances. A log should immediately be started and anyone leaving or entering the cave via any entrance should be logged in or out and details as to their assignment and the equipment they are carrying in should be logged as well.

A.13.2.3(7) Documents for the collection and recording of information can include the following:

(1) Information regarding the lost person(s)
(2) Entrance(s) control logs
(3) Information needed to determine search urgency
(4) Information required by the AHJ
(5) Information required by the incident management system (IMS)
(6) Information required to identify a subject's track (i.e., footprint)
(7) Information for development of search strategy

A.13.2.3(8) Isolation includes keeping the reporting party readily available for interviewers and isolated from media and the incident operations, as well as isolated from one another, in the case of multiple reporting parties.

A.13.3.2.1 In some cases, where minimum exposure to cave hazards exists, it can be appropriate for the AHJ to establish SOPs that permit an operations-level organization to conduct certain search and rescue operations without supervision of a technician-level organization. As a minimum, the members of the operations-level organization entering the cave should have the following:

(1) Proficiency in crawling, climbing, and moving over uneven surfaces and breakdown areas covered in mud, sand, or water

(2) Familiarity with chimneying, bridging, and other basic climbing techniques used in moving through caves
(3) Ability to move comfortably and efficiently in small spaces
(4) Ability to carry personal equipment and rescue equipment through the cave
(5) Ability to identify fragile cave environments and take measures to protect them
(6) Ability to maintain primary light sources
(7) Ability to be self-sufficient underground for 24 hours
(8) Ability to read cave maps and the special symbols associated with them
(9) Ability at both rappelling and ascending drops of 100 ft (30.48 m) or more, often in free fall
(10) Ability to change over from rappel to climbing and climbing to rappel in adverse situations such as complete darkness and in waterfalls
(11) Ability to pass a knot on rappel or ascent
(12) Ability to pass a re-belay point in-cave

A.13.3.3(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident, including whether it is a search, rescue, or body recovery
(2) Assessment of time required
(3) Assessment of staffing needs
(4) Specific environmental factors involved
(5) Integrity and stability of the environment involved
(6) Number of known/potential victims
(7) Weather (current and forecast)
(8) Time to locate patient at unknown location in cave
(9) Difficulty of real-time communication flow underground
(10) Travel time to know patient location
(11) Transport time of patient(s) in restricted cave passage
(12) Vertical rigging challenges
(13) Logistical issues with rotation of rescuers and/or resupply and rehabilitation of rescuers in place underground

A.13.3.3(2) See A.13.2.3(3).

A.13.3.3(3) Organizations should have access to a basic understanding of the cave environment, including their regional differences in ambient cave temperature, normal hazards such as risk of hypothermia, and risk of potential changes in cave environment due to seasonal variations and outside weather.

A.13.3.3(4) Organizations should have special knowledge and equipment for medical treatment and patient transport specific to cave rescue, which can include the following:

(1) Familiarity with use of vapor barriers for in-cave patient protection from wind and water
(2) Familiarity with confined space drag sheet–type patient transport devices (such as the SKED® and Half-SKED®), spinal immobilization devices with built-in patient lift harness (for evacuation purposes), solid basket litters, and ability to identify litters appropriate for small spaces
(3) Practical experience in moving litters through long, narrow, uneven spaces

A.13.3.3(6) Personal support equipment should include that which is necessary to address the following needs, or potential needs, of a rescuer in a cave setting:

(1) Three sources of light, helmet mountable and capable of allowing the rescuer to enter the cave
(2) Personal medical (first aid) supplies
(3) Additional clothing appropriate for anticipated environment/weather
(4) Fluids and food appropriate for mission duration
(5) Personal safety and comfort gear [e.g., insulated pads for sitting on, shelter, body waste management container(s)]
(6) Navigation tools (e.g., compass, map)
(7) General marking and documentation tools (e.g., flagging tape, paper/pencil)
(8) Improvisational tools (e.g., wire, twine, leaf bag, safety pin)
(9) Emergency shelter, bivouac, and/or body protection
(10) Emergency communications (e.g., whistle, glow stick, candle)
(11) Cave-suitable pack for contents

A.13.3.3(7) The AHJ should establish procedures for negotiating and/or avoiding conditions and hazards specific to the cave environments and terrains in which rescuers can become involved. It is likely that some conditions and/or situations will exceed the capability of the organization. In such situations, additional, more experienced, specialized, or highly trained resources should be procured. It is possible that rescuers will have more than 6 hours travel time inside a cave that requires confined space, swift water, and vertical rope ascending and descending skills just to reach an injured patient in a cave. Having a pre-incident working relationship with local cavers who have been trained in cave rescue skills is an excellent way to augment the AHJ's cave rescue response. The National Cave Rescue Commission of the National Speleological Society provides training specific to the cave environment for both cavers and professional rescue resources.

A.13.3.3(13) Caves are often direct drainage for rainwater falling in the immediate area and in some cases from miles away. Weather forecast and local knowledge of drainage patterns should be used to prevent rescuers from being caught in or trapped by rising water.

A.13.3.3(14) Skills involved in supporting and participating in a search should include, but not be limited to, the following:

(1) Hasty, efficient, and thorough search techniques
(2) Principles of confinement of the search area
(3) Principles and importance of clue awareness
(4) Basic search theory application and terminology
(5) Principles of lost person behavior
(6) Procedures for serving as an air observer (e.g., searching from an aircraft)
(7) Procedures for handling, processing, and documenting evidence

A.13.3.3(17) The ability to discern limitations in accessing and/or evacuating should be based on the following:

(1) Individual and team expertise
(2) Qualified personnel available
(3) Ability to communicate from the patient scene
(4) Anticipated staffing and time

A.13.3.3(21) The organization should have the ability to establish communication system(s) appropriate for the cave environment and distance from incident command, including the following:

(1) Access to and ability to install wired communications
(2) Ability to operate field telephones

(3) Access to and ability to operate low-frequency cave radios
(4) Message rnnners if the above are not available

A.13.4.4 Cave search and rescue organizations at the technician level are not required to develop and maintain capabilities in all types of cave search and rescue operations [e.g., flooded or underwater caves, cave diving and recovery, and vertical over 200 ft (60.95 m)].

A.13.4.5(4) Members of an organization at the technician level should be adept and experienced at every skill required of subordinate personnel. Technician-level organizations should have the capability to address any potential operation that falls within their jurisdiction. To accomplish this, members of these organizations should be personally adept at cave skills, travel, and operations in the cave setting.

A.13.4.5(5) Such an operational plan should be based on the hazard identification and risk assessment performed according to Section 4.2, available resources, environmental influences and conditions, and the urgency of the situation. Specifically with regard to a search, the implemented plan should involve planning and search management techniques, including, but not necessarily limited to, the following:

(1) Determining the urgency of the search
(2) Developing a lost subject profile
(3) Establishing the search area and correctly dividing it into regions and segments as necessary
(4) Conducting an appropriate investigation and interviews
(5) Applying the mathematical concept of probability and search theory
(6) Designing, developing, and establishing appropriate search strategy and tactics
(7) Establishing and managing appropriate base camp
(8) Briefing and debriefing of operational personnel properly and thoroughly
(9) Considering suspension of the search when appropriate
(10) Demobilizing personnel and facilities
(11) Documenting the incident properly

A.14.1.2 Procedures for active underground structures and excavations are well covered by existing standards and regulations such as those of the Mine Safety and Health Administration (MSHA). In addition, existing regulations and standards address general operations in underground structures such as subway stations, road tunnels, and parking garages. This chapter is intended to address the requirements of search and rescue operations in and around inactive or abandoned underground structures and excavations, sometimes when the safety systems addressed by other standards and regulations have been compromised. "Search and rescue" in this context does not include fire-fighting operations in general, which are also covered by other standards and regulations.

Surface mines such as quarries and open pits are outside the scope of this chapter.

A.14.1.2.2 Generally, underground structures and excavations do not qualify as permit-required confined spaces such as those addressed in 29 CFR 1910.146 and/or equivalent local regulations, due to the long distances and other unique characteristics. However, tunnels or mines could have equipment, spaces, or areas that do meet the criteria for confined spaces. It is not the intent to exclude those areas from the requirements of other chapters in this document.

A.14.1.3 In the United States, the Department of Labor's Mine Safety and Health Administration (MSHA) has established regulations for mine rescue teams at operating mines. Tunnels under construction are regulated by the Occupational Safety and Health Administration (OSHA) or by equivalent state agencies.

A.14.1.3.2 The requirements of this section should be confirmed by an annual evaluation of the search and rescue organization's capabilities to perform mine and tunnel rescues in terms of overall timeliness, training, and equipment and to perform safe and effective search and rescue in those types of situations to which the team must respond.

A.14.1.3.4 Representative mines and tunnels should — with respect to opening size, configuration, and accessibility — simulate the types of mines and tunnels from which rescue is to be performed.

A.14.1.3.5 The term *timely* is based on many factors, such as perceived danger of the original entry (e.g., possible supplied breathing air required), distance to definitive medical care, capabilities of responding emergency medical services, and so forth. In trauma-related injuries, the "golden hour" principle can be used to determine how quickly the search and rescue organization should be able to respond to deliver the patient to the appropriate treatment facility within an hour of onset of injuries. The search and rescue organization should have a goal of responding to these emergencies within 15 minutes of the time they receive notification. OSHA 1926.800(g)(5) includes response time requirements for tunnel rescue teams.

A.14.1.4 U.S. federal regulations (30 CFR 49.2) require five members and one alternate for rescue teams to perform entry at working mines. The intent of the minimum staffing requirements in this document is to provide for adequate staffing to mobilize an appropriately sized entry team to perform the mission, provide for immediate rescue of team members, assist with victim packaging, and movement under long and difficult conditions. Nothing in this document is intended to mandate a minimum or maximum size of the actual entry team.

A.14.2.3(3) Hazards can include, but are not limited to, the following:

(1) Hazardous atmospheres
(2) Hazardous chemicals
(3) Temperature extremes
(4) Fall hazards
(5) Moving equipment

Some methods of recognition and assessment of hazards associated with mines and tunnels include, but are not limited to, the following:

(1) Assessment of the perimeter surrounding the mine or tunnel incident to determine the presence of or potential for a hazardous condition that could pose a risk to rescuers during approach
(2) Recognition of the need for decontamination of a patient or responder who might have been exposed to a hazardous material as per Chapter 11 of NFPA 472 and OSHA regulations in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
(3) Recognition of the need for a search and rescue organization or additional resources

(4) Notification of the designated search and rescue organization and other resources necessary for initiation of mine or tunnel rescue
(5) Recognition of hazardous atmospheres or materials through visual assessment and information received from on-site personnel
(6) Recognition of potential fall hazards in and around the site
(7) Recognition of potential hazards associated with open excavations in and around the site

A.14.2.3(4) The term *tunnel* refers to a covered excavation used for the conveyance of people or excavations that are, or will be, connected to the tunnel, including shafts and trenches.

Underground mines are a series of tunnels and shafts underground used to obtain something from the soil through which they are excavated.

Tunnels and mines differ from each other in that in the construction of a tunnel the final product is the hole in the earth and the removed soil is a by-product of that process, while in mining, the tunnel is a by-product of the process of removing the soil.

A.14.2.3(5) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources. In addition, the system includes procurement of on-site information resources such as witnesses, entry supervisors, facility managers, engineers, or other responsible persons. Common formal information sources can include, but are not limited to, the following:

(1) Accountability system — which may be a "brass board," sign-in log, or other means of personnel accountability
(2) Chemical information documents (i.e., SDS)
(3) Other site work permits
(4) Shift log or tie-over book
(5) Emergency response plan
(6) Mine maps (older abandoned mines might not have maps readily available, although local Mine Safety and Health inspectors might have these records archived from when the mine was active)
(7) Engineering drawings

A.14.2.3(6) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This process might include management of all civilian and nonemergency personnel and establishment of operational zones and site security. The organization should also ensure through written standard operating guidelines that the scene is rendered safe at the termination of the incident.

A.14.3.3(1) The assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Hazards such as engulfment potential, environmental hazards (e.g., chemical, atmospheric, temperature), harmful forms of energy (e.g., electrical, mechanical, movement due to gravity, hydraulic), configuration hazards (e.g., diverging walls, entrapment, obstructions, trip/fall hazards), and so forth
(2) Risk/benefit analysis (body recovery versus rescue)
(3) Available and necessary additional resources
(4) Establishment of control zones
(5) Magnitude of the hazard and isolation procedures
(6) Effectiveness of the non-entry or qualifying entry–type rescue
(7) Overall safety of search and rescue operations
(8) Level of search and rescue response (appropriate for the type of operations being attempted)
(9) Current and projected status of the planned response
(10) Personnel accountability

A site safety plan can also provide useful information for consideration during size-up and should include the following:

(1) Search and rescue team notification
(2) Acceptable entry conditions for rescue
(3) Hazard identification
(4) Risk assessment of hazards
(5) Site map
(6) Hazard abatement (including control zones, ventilation, and lockout/tagout procedures)
(7) Use of buddy system (where applicable)
(8) Communications (e.g., site, rescue attendant to rescue entrant)
(9) Command post
(10) Incident management organizational chart
(11) Standard operating guidelines
(12) Safe work practices
(13) Medical assistance
(14) Pre-entry safety briefings
(15) Pre- and postentry physicals (if indicated)

A.14.3.3(3) The AHJ should address the possibility of members of the organization having physical and/or psychological disorders (e.g., physical disabilities, fear of heights, fear of enclosed spaces) that could impair their ability to perform in mines or tunnels.

A.14.3.3(4) Roles, functions, and responsibilities for these team positions should be consistent with the organization's standard operating guidelines for mine and tunnel rescues.

A.14.3.3(5) See A.7.3.6(5).

A.14.3.3(6) The requirement for emergency egress respiratory protection can be satisfied with a self-contained self-rescuer device designed and approved for use in a mine or tunnel environment, such as those meeting the requirements of MSHA/NIOSH.

A.14.3.3(7) The intent of this item is to restrict entries made by operations-level organizations to those that would absolutely minimize risk to rescue entrants. It is the intent of this document that operations-level teams not perform hazardous entries.

A.14.3.3(7)(i) The intent of this item is to allow for easier retrieval of rescue entrants should this become necessary and to provide for passage through the opening without removal of necessary PPE, including fresh air breathing apparatus.

A.14.3.3(7)(j) The intent of this item is to allow a "buddy system" to be employed, providing potentially faster response to a problem with one of the rescue entrants.

A.14.3.3(7)(k) The intent of this requirement is to ensure that hazards to rescuers in organizations at this level are kept to an absolute minimum.

A.14.3.3(8) "Packaging devices" that can be used in mines and tunnels include, but are not limited to, the following:

(1) Full spine immobilization devices
(2) Short spine immobilization devices
(3) Cervical spine immobilization devices
(4) Litters
(5) Prefabricated full-body harnesses
(6) Tied full-body harnesses
(7) Wrist loops (wristlets)

A.14.3.3(11) Organizations at the operations level are expected to safely apply lowering and raising systems (rope- or non-rope based) as appropriate during mine or tunnel emergencies. These applications can involve the use of rope rescue systems in the high-angle environment both to lower rescuers into and to remove rescuers and victims from mines and tunnels. The determination of what systems are most appropriate to accomplish these tasks should be dictated by the circumstances surrounding the incident.

A.14.4.2 While five people are the recommended minimum for most entry-type mine and tunnel rescue operations, some such rescues will require more or fewer rescuers. The number of personnel required should be determined by the situation, hazards, and degree of difficulty of the situation confronted. A team is "qualified" by its capability as a team, not by the individual qualifications of its members.

A.14.4.2.1 Depending on the size of the space, its configuration, and associated travel distances, it might be more beneficial to have all or a portion of the backup team positioned inside the space at a fresh air base or forward staging area.

A.14.4.2.2 The requirement for emergency egress respiratory protection can be satisfied with a self-contained self-rescuer device designed and approved for use in a mine or tunnel environment, such as those meeting the requirement of MSHA/NIOSH.

A.14.4.2.4 "Verbal" in this context means any method of conveying voice messages from one person to another, including direct speech and electronic technology.

A.14.4.2.4.1 Tunnels under construction in particular have specific action levels for certain contaminants, such as methane, which might vary from more conventional action levels for atmospheric hazards.

A.14.4.2.6 The requirement of this section can be met by having each entry team member wear an MSHA/NIOSH-approved oxygen generating self-rescuer.

A.14.4.3(6) The size-up/assessment at this level should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Available and necessary additional resources
(2) Hazard isolation and control requirements

A.14.4.3(7) Procedures should be consistent with local, state, and federal guidelines, such as those found in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER).

A.14.4.3(8) See Annex G.

A.14.4.3(9) The health and safety regulations regarding the construction of tunnels apply to all. See 3.3.155 for the definition of tunnel. Also see Annex G.

A.15.1.2 One intent of this chapter is to distinguish between three levels of capability for organizations using helicopters at search and rescue operations. Organizations at the awareness level are capable of recognizing hazards, using PPE, and implementing techniques necessary to operate in the vicinity of the helicopter. Organizations at the operations level are capable of recognizing hazards, using PPE, and implementing techniques necessary to operate in a support function inside and immediately outside of a helicopter. Organizations at the technician level are capable of recognizing and mitigating hazards, using helicopter search and rescue equipment, and performing advanced search and rescue helicopter techniques, both inside and outside the aircraft, commensurate with the needs of the organization.

A.15.2.2(8) General hazards include, but are not limited to, temperature, altitude, rain, wind, fog, snow, utility wires/poles, trees/canopy, and loose debris, any of which could impede safe operation and/or performance of a helicopter.

A.15.2.2(9) The AHJ shall ensure that all personnel wear and use PPE during helicopter search and rescue operations. Personal protective equipment should, as a minimum, include an appropriate helmet, eye protection, hearing protection, protective clothing appropriate for the environment, footwear, and gloves.

A.15.2.2(12) A pre-flight safety briefing should include, but not be limited to, the following:

(1) Rotor hazard zones
(2) Safely approaching and departing from the helicopter
(3) Use of safety belts
(4) Operation of doors and emergency exits
(5) Location of survival equipment
(6) Location and use of required flotation equipment
(7) Location and operation of fire extinguishers
(8) Location and operation of emergency locator transmitter (ELT)
(9) Location and operation of emergency fuel shutoff
(10) Crash and emergency procedures

A.15.3.2(2) Standard crew complements can be addressed in existing guidance, such as the *International Aeronautical and Maritime Search and Rescue Manual*. However, no fewer than one observer, in addition to the pilot, is recommended in an aircraft during helicopter search operations and, no fewer than two personnel (one a rescuer, one a crew chief/spotter), in addition to the pilot, are recommended in an aircraft during helicopter rescue operations.

A.15.3.2(5) Crash egress and survival training appropriate to the environment includes being taught how to exit the helicopter post-crash and how to survive in any environment that might be encountered in the area of operation until rescued.

A.15.4.2(6) For more information, see the *Aeronautical Information Manual* (AIM) (or a similar document), available at www.faa.gov.

A.15.4.2(7) A temporary landing zone is any nonpermanent location selected for a helicopter to land away from an airport. A helispot is an incident command system (ICS) term for a similar location that is defined as "a location where a helicopter can take off and land; some helispots may be used for temporary loading."

A.16.2.3(2) The assessment phase includes an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue. Consideration should be given to the need for

other types of water rescue early in the assessment phase. The best intended surface rescue could eventually require other capabilities.

A.16.2.3(3) See A.4.2.5.

A.16.2.3(4) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.16.2.3(5) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.16.2.3(6) General hazards associated with water search and rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *Utilities.* Control of the utilities in and around a water incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment for them to operate in and to ensure the safety of victims. The following utilities should be considered when providing training:
   (a) Electrical services (primary and secondary)
   (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (c) Water/steam
   (d) Sanitary systems
   (e) Communications
   (f) Secondary service systems (such as compressed, medical, or industrial gases)

(2) *Hazardous Materials.* Water incident sites might include various materials unique to a site that, when released during a search and rescue operation, could pose a hazard to victims and responders. The AHJ should provide its members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.

(3) *Personal Hazards.* At the site of any water incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train its members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure members' safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(4) *Confined Space.* Some water incident sites necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to its members in confined space rescue.

(5) *Hazards That Are Immediately Dangerous to Life and Health.* These hazards include swift water with currents exceeding those in which a person or watercraft can safely and effectively operate.

(6) *Other Hazards.* There are numerous other hazards associated with water search and rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide its members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.

(7) *General Area.* The general area around a water incident site is the entire area around a search and rescue site. Any member operating within the vicinity of the water's edge can accidentally enter the hazard zone. PPE should be utilized accordingly. Making the general area safe includes, but is not necessarily limited to, the following:
   (a) Controlling/limiting access to the area by unnecessary personnel
   (b) Identifying hazards and removing or reducing their impact
   (c) Using personal flotation devices (PFDs) and other PPE

A.16.2.3(7) While in rescue mode, the assessment to move to recovery is an ongoing process that should be updated as incident information becomes available. The AHJ should have procedures in place to optimize the survivability of the potential victim during this process. This typically includes actions that maximize the benefit to the subject but pose minimal risk to the responder. At the awareness level there is little action expected of responders that could introduce risk to the operation. Consequently, the bias should lean toward rescue mode unless there is a clear indication that the event is not survivable. As resources with greater capability arrive, the ability to conduct a more comprehensive risk benefit analysis can be conducted. Figure A.16.2.3(7) illustrates just one example of how contributing factors can be compiled into a risk benefit analysis for surface water rescue operations.

A.16.3.3 For the purposes of this chapter, a rescue watercraft includes powered and non-powered vessels and craft that are intended to carry rescuers and victims. It is not intended to include rescue devices such as swim aids, paddle boards, and rescue boards that might accommodate a victim but are typically not classified as vessels or watercraft.

The intent of 16.3.3 is to ensure that members responsible for operating the watercraft or its equipment and systems are trained to perform the related functions under conditions that are as similar as possible to the most demanding potential work environment. This requirement does not to apply to rescuers aboard the watercraft who are using the craft as a work platform to fulfill the rescue mission and whose primary function is exclusive of operating the vessel or its systems.

A.16.3.4 For the purposes of this chapter a rescue watercraft includes powered and non-powered vessels and craft that are intended to carry rescuers and victims. It is not intended to include rescue devices such as swim aids, paddle boards, and rescue boards that might accommodate a victim but are typically not classified as vessels or watercraft. The intent of 16.3.4 is to ensure that members responsible for actually operating the watercraft or its equipment and systems are trained to perform the related functions under conditions that are as similar as possible to the most demanding potential work environment. This requirement does not apply to rescuers aboard the watercraft who are using the craft as a work platform to fulfill the rescue mission and whose primary function is exclusive of operating the vessel or its systems.

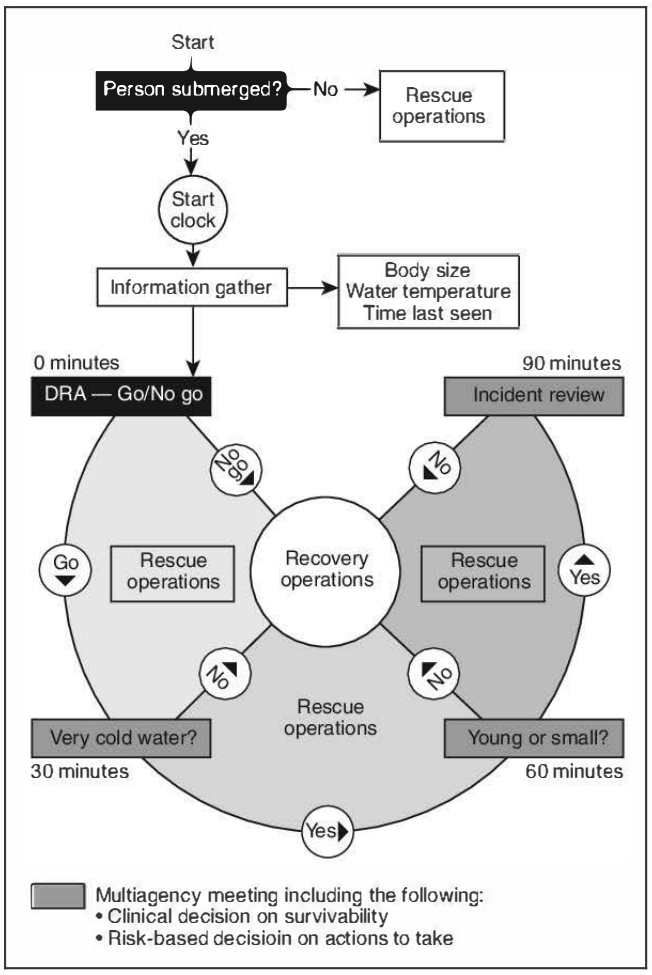

FIGURE A.16.2.3(7) UK Submersion Guidelines. ***(Courtesy of the UKFRS National Operational Guidance Programme.)***

A.16.3.5(1) The victim survival window will depend on many factors, including whether the victim's location is known, water and weather conditions, immersion time, age, physical condition, and factors that contributed to the immersion such as injury or illness. Medical research is continually providing new information on criteria that impacts the survival of near-drowning victims. Agencies that perform these rescue operations should have adequate guidance available to potential rescuers to determine the likelihood of survival of water-bound victims. See Figure A.16.2.3(7) for awareness-level surface water rescue.

A.16.3.5(2) Risks associated with water rescue operations can be dynamic, involving tides, weather, water conditions, and other factors that the rescuer cannot influence as part of the rescue plan. There are also components of the risk assessment that can be influenced by the agency, both in the planning phase and in the response phase. These include the size and capabilities of the rescue team and the condition of its members, the establishment of intervention resources or procedures, facilitating methods of removal or egress of rescuers from the hazard zone, rescue equipment provided, and the staffing levels of responding teams. The risk level can typically be adjusted or moderated as additional resources are moved into place, but this is often at the expense of the survivability profile as time continues to elapse.

A.16.3.6 For the purposes of this chapter, the PPE is intended to protect a rescuer from the effects of accidental immersion and to help facilitate timely removal from the water to ensure survival. Rescuers at the operations level are not expected to enter the water as part of the rescue plan. The term "hazard zone" as it is used here is intended to describe areas where the combination of water depth and the likelihood for accidental immersion pose a risk toot the responder. It is recognized that additional PPE might be required based on the task the rescuer has been assigned, environmental conditions, physical hazards, and other factors that could pose a risk to the responder.

A.16.3.6(1) Flotation aids, personal flotation devices, and other water-related PPE can come with a range of certifications and approvals from various national and international agencies. The same PFD might not be appropriate for all water rescue incidents to which the agency responds, or even for to rescuers with different roles at the same incident. The intent of 16.3.6(1) is that the device be capable of being worn or attached to the rescuer and will provide no less than 15.5 lb of inherent or on-demand positive buoyancy. The AHJ is responsible to perform a task analysis and to ensure that responders are provided the proper PPE for the work to be performed.

Agencies that provide information for approval for such devices include the following:

(1) The Lifesaving and Fire Safety Division of the United States Coast Guard
(2) The Office of Boating Safety of Transport Canada

CE and ISO standards deal with various categories of buoyancy performance. The rating is for an adult size, so smaller sizes have proportionally less buoyancy:

(1) EN 393 (ISO12402-5), covers buoyancy aids, providing a minimum of 5 kg of buoyancy. Products that carry this approval include anglers vests, waterski vests, personal watercraft vests, wakeboarding vests, and various dinghy and canoe vests.
(2) EN 395 (ISO12402-4), covers lifejackets, providing a minimum of 10 kg of buoyancy. Products that carry this approval include foam lifejackets for both adults and children.
(3) EN 396 (ISO12402-3), covers lifejackets providing a minimum of 15 kg of buoyancy. Products that carry this approval include the majority of manual and automatic lifejackets for both adults and children.
(4) EN 399 (ISO12402-2), covers lifejackets providing a minimum of 27.5 kg of buoyancy. Products that carry this approval include lifejackets for offshore use.

In addition to "approved" PFD's, the AHJ might designate hazard- or mission-specific PPE or rescue tools as providing a trained responder sufficient reserve buoyancy, negating the need for an additional PFD. Examples include inherently buoyant ice rescue suits, diving buoyancy compensators and water rescue floatation cans with a leash.

A.16.3.6(3) This would include reflective striping, strobes, flashlights, chemical light sticks, or other light sources as recognized by the AHJ.

A.16.3.7(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope, magnitude, and nature of the incident

(2) Location and number of victims
(3) Risk benefit analysis
(4) Separation, isolation, security, and interviewing of witnesses
(5) Hazards such as disrupted or exposed utilities, standing or flowing water, mechanical hazards, hazmat, and explosives
(6) Access to the scene
(7) Environmental factors
(8) Resource assessment, internal and external
(9) Rescue versus recovery

A.16.3.7(2) These procedures include, but are not limited to, ensuring rescuers are wearing the wearing of proper PPE, using procedural checklists, ensuring site security (keeping bystanders back), reviewing the operational plan (and one's place in the plan), reviewing communications procedures (rescuer to tender, tender to shore, rescuer to rescuer), reviewing emergency procedures, wearing proper attire for the potential weather, reviewing procedures for equipment handling, and ensuring proper rest and attitude for the operation. For positive outcomes, water rescue requires a combination of knowledge, skills, abilities, physical fitness, and judgment. All will be gained through a combination of training and experience.

A.16.3.7(3) Hazards to both victim and rescuer include, but are not limited to, the following:

(1) Holes
(2) Strainers
(3) Hydraulics
(4) Low head dams
(5) Debris
(6) Cold water
(7) Currents
(8) Undercuts
(9) Backwash
(10) Outwash
(11) Contamination
(12) Obstructions
(13) Turbidity

A.16.3.7(6) It is important that the organization be capable of to continuously evaluating the effectiveness of the chosen plan of action. If the initial plan is not working, or requires modification to ensure safety or effectiveness, the plan should be changed. The potential for "tunnel vision" (a narrow focus excluding important influences) should be considered by those running the operation.

A.16.3.7(7) Shore-based rescues include, but are not limited to, reaching to a victim, throwing something to a victim (e.g., rope, buoy), and talking a victim into self-rescue. Items readily available on shore can be used to reach to a victim in the water while not exposing the rescuer to undue risk. Important aspects of reaching techniques include body position and reaching device selection (i.e., anything that can be used to extend a rescuer's reach). Many items found on shore (e.g., throw bag, PFD, ring buoy, manufactured flotation or rope-throwing devices) can be thrown to a victim to use as a flotation device or to pull the victim to shore.

A.16.3.7(8) The accurate use of throw bags takes practice and knowledge of proper body position, throwing technique, rope retrieval technique, and target selection (e.g., upstream in moving water, slightly beyond the victim).

A.16.3.7(9) Members of organizations at the operations level should have the ability to assist other rescue personnel with the construction of rope rescue systems. Skills involved in supplying this assistance include, but are not limited to, equipment identification, knot-tying capability, and limited knowledge of how the applicable rope rescue equipment should be used.

A.16.3.7(10) The intent of 16.3.7(10) is to include both incident-specific actions, such as staging of resources (e.g., ladders, life rings, vessels, or standby swimmers) for the intervention of rescuers, and organizational elements, such as training members on accidental immersion survival and removal tactics for the specific conditions responders are likely to encounter.

Procedures for survival swimming and self-rescue from entrapment are important because a rescuers might find themselves unintentionally in the water and trapped. These procedures should include, but are not limited to, the following abilities:

(1) Floating and swimming with and without flotation
(2) Conserving body heat while immersed in water (heat escape–lessening position)
(3) Using one's clothing for flotation
(4) Removing oneself from the water by climbing into a boat and, exiting at shore, from a pool's edge
(5) Extricating oneself from foot, body, and equipment entanglements

A.16.3.7(11) Environmental conditions such as weather and temperature play an important role in a rescuer's safety and comfort. Cold temperatures can lead to hypothermia and/or local cold injuries that can seriously impair a rescuer's ability to think and act. Wetness, through perspiration or from the environment, can substantially increase the speed at which a rescuer becomes affected by cold. Therefore, thermal protection from the elements is essential for safe operations in cold and wet environments.

It is also very important to remember that all environments can lead to heat stress as well. For example, much of the apparel designed for rescue operations is waterproof and insulated to protect the rescuer from wetness and heat loss. Unfortunately, such garments impair the body's most effective means of thermal regulation: the evaporation of perspiration from the skin. In all environments and conditions, rescuers wearing PPE should be monitored for thermal stress (e.g., overheating). Pre-operation physical exams, appropriate hydration/nutrition, and monitored rehabilitation are essential for safe operations and healthy personnel.

A.16.3.7(14) Boat-based operations include, but are not limited to, the capability to perform surface support operations from within a boat while in surf, on the water, or on ice (whichever is applicable). Agencies that operate watercraft as part of their rescue operation would comply with the watercraft chapter of this document.

A.16.3.7(16) Accessible victims are those who can be retrieved without the rescuer having to venture out onto the ice or into the water.

A.16.3.7(18) This might include methods of search, stabilization, or access that do not require rescuers to enter the water or the water-bound vehicle.

A.16.4.3(3) The intervention plan might include one or more of the following: the use of a back-up rescuer(s), downstream safety, team, spotters, standby watercraft, and retrieval lines or ladders.

A.16.4.3(4) For example, establish a last seen point as a primary search area.

A.17.2.3(2) The assessment phase includes an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue. Consideration should be given to the need for dive rescue early in the assessment phase. The best intended surface rescue could eventually require dive capability.

A.17.2.3(3) See A.4.2.5.

A.17.2.3(4) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.17.2.3(5) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.17.2.3(6) General hazards associated with water search and rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(1) *Utilities.* Control of the utilities in and around a water incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment for them to operate in and to ensure the safety of victims. The following utilities should be considered when providing training:
   (a) Electrical services (primary and secondary)
   (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (c) Water/steam
   (d) Sanitary systems
   (e) Communications
   (f) Secondary service systems (such as compressed, medical, or industrial gases)

(2) *Hazardous Materials.* Water incident sites might include various materials unique to a site that, when released during a search and rescue operation, could pose a hazard to victims and responders. The AHJ should provide its members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.

(3) *Personal Hazards.* At the site of any water incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train its members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure members' safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(4) *Confined Space.* Some water incident sites necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to its members in confined space rescue.

(5) *Hazards That Are Immediately Dangerous to Life and Health.* These hazards include swift water with currents exceeding those in which a person or watercraft can safely and effectively operate.

(6) *Other Hazards.* There are numerous other hazards associated with water search and rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide its members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.

(7) *General Area.* The general area around a water incident site is the entire area around a search and rescue site. Any member operating within the vicinity of the water's edge can accidentally enter the hazard zone. PPE should be utilized accordingly.

Making the general area safe includes, but is not necessarily limited to, the following:

(1) Controlling/limiting access to the area by unnecessary personnel
(2) Identifying hazards and removing or reducing their impact
(3) Using personal flotation devices (PFDs) and other PPE

A.17.3.4(3) Further requirements of PPE are included in 4.4.2 of this standard. This requirement applies to all the described disciplines.

A.18.2.3(2) The assessment phase includes an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue. Consideration should be given to the need for dive rescue early in the assessment phase. The best intended surface rescue could eventually require dive capability.

A.18.2.3(3) See A.4.2.5.

A.18.2.3(4) The emergency response system includes, but is not limited to, operations and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.18.2.3(5) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

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(a) Controlling/limiting access to the area by unnecessary personnel
(b) Identifying hazards and removing or reducing their impact
(c) Using personal flotation devices (PFDs) and other PPE

A.18.2.3(7) See language on rescue versus recovery in Chapter 16. Additionally, the search for a missing diver should include an assessment of the diver's experience, the type of equipment the diver was using, and the estimated remaining air supply balanced against the depth of the water and other conditions.

A.18.3.4(1) See the annex material in Chapter16 for more information on PFDs.

A.18.3.5(1) Hazards associated with dive operations include, but are not limited to, the following:

(1) Barotraumas (decompression sickness, nitrogen narcosis, oxygen toxicity, etc.)
(2) Drowning
(3) Hyperventilation, hypercarbia, and other respiratory problems
(4) Anxiety reactions
(5) Fatigue and exhaustion
(6) Dehydration (electrolyte imbalances)
(7) Heat stress (i.e., heat exhaustion, stroke, and cramps)
(8) The combination of prescription medication or smoking and diving
(9) Pre-existing medical conditions or injuries
(10) Hypothermia

A.18.3.5(2) Support personnel are called upon to assist divers in preparing to dive and to dress and equip divers; to provide search pattern control and direction; to monitor divers' time, depth, dive profile, and air supply; and to provide a communication link to the surface via electronic communication equipmentor manual rope pull signals.

A.18.3.5(4) Surface support personnel should be capable of recognizing, maintaining, and operating all surface support equipment used by the organization.

A.18.3.5(7) Darkness or unusual or extreme environmental conditions can require very specialized dive and/or surface support training specific to the situation(s) encountered.

A.18.4.4 Training in SCUBA diving should include, but not be limited to, the information conveyed in a widely recognized SCUBA diving program that emphasizes the role of a public safety agency or rescue organization in dive operations.

A.18.4.5 Fitness provides reserve capacity to deal with physical challenges that can occur during dive operations. Research indicates that the fitness evaluations specified in Figure A.18.4.5(a) and Figure A.18.4.5(b) provide a minimum aerobic capacity to SCUBA dive safely. Annual skill evaluations help ensure diver competence relative to fundamental survival skills. Many investigators, researchers, and authors support the belief that poor SCUBA skills are a direct or indirect cause of diver fatalities.

A.18.4.6(1) The dive supervisor is responsible for the overall management of the dive operation. At a minimum, dive supervisors possess the same knowledge and understanding of hyperbaric work as the divers and generally exceed the skill set and authority of a dive tender. The term *dive supervisor* is a term used in many commercial or governmental standards on diving and will often have a specific definition and scope of authority.

A.18.4.6(3) It is the intent of the requirement that the safety diver, also called the *backup diver*, be prepared to immediately descend and contact a diver in distress or search for a missing diver. To accomplish this, the safety diver is typically in the water with all equipment, including a face piece, in place and ready to submerge. He/she must maintain a constant situational awareness of the general location of the divers and of any unusual events or circumstances that might require deployment. In cases where depth or distance makes timely deployment of a safety diver impractical, deploying two divers as partners might be required to manage any potential diver emergencies.

I.A.D.R.S. Annual Watermanship Test / Skills Test

Annual Watermanship Evaluation Parameters

There are four exercises that evaluate stamina and comfort in the water, each rated by points. The diver must successfully complete all stations and score a minimum of 12 points to pass the test.

Stamina Exercise 1: 500 yard Swim

The diver must swim 500 yards without stopping using a forward stroke and without using any swim aids such as dive mask, swim goggles, fins, snorkel, or flotation device. Stopping or standing up in the shallow end of the pool at any point during this exercise will constitute a failure of this evaluation station.

Time To Complete	Points Awarded
Under 10 minutes	5
10 to 13 minutes	4
13 to 16 minutes	3
16 to 19 minutes	2
More than 19 minutes	1
Stopped or incomplete	Incomplete

Stamina Exercise 2: 15 Minute Tread

Using no swim aids and wearing only a swimsuit, the diver will stay afloat by treading water, drown-proofing, bobbing, or floating for 15 minutes, with hands only out of the water for the last 2 minutes.

Performance Criteria	Points Awarded
Performed satisfactorily	5
Stayed afloat, hands not out of water for 2 minutes	3
Used side or bottom for support at any time	1
Used side or bottom for support > twice	Incomplete

Stamina Exercise 3: 800 yard Snorkel Swim

Using a dive mask, fins, snorkel, and swimsuit (no BCD or other flotation aid) and swimming the entire time with the face in the water, the diver must swim nonstop for 800 yards. The diver must not use arms to swim at any time.

Performance Criteria	Points Awarded
Under 15 minutes	5
15 to 17 minutes	4
17 to 19 minutes	3
19 to 21 minutes	2
More than 21 minutes	1
Stopped at any time	Incomplete

Stamina Exercise 4: 100 yard Inert Diver Rescue Tow

Wearing full scuba equipment and breathing air, the diver must push or tow an inert diver wearing dive gear on the surface 100 yards nonstop without assistance.

Performance Criteria	Points Awarded
Under 2 minutes	5
2 to 3 minutes	4
3 to 4 minutes	3
4 to 5 minutes	2
More than 5 minutes	1
Stopped at any time:	Incomplete

Additional copies available at no charge via the International Association of Dive Rescue Specialists webpage. Visit www.IADRS.org

FIGURE A.18.4.5(a) Watermanship/Skills Test.

I.A.D.R.S. Annual Basic Scuba Skills Evaluation

Diver's Name: _____ Department: _____

Air Consumption: Start _____psi / Finish _____psi Time: Start _____ / Finish _____ / Total _____

Water Depth: _____Pool / Open Water (circle one) Examiner: _____

Task grading: S = Satisfactory N = Needs Improvement (specify) N/A = Not Applicable (use for equipment only)

Equipment Handling and Set-Up

_____ properly assembles equipment (basic gear / specialty gear)
_____ shows familiarity and comfort with equipment
_____ properly protects equipment (i.e. tank valve / regulator)
_____ review (line & hand signals / air consumption rates / buddy awareness / emergencies / diver log)

Watermanship Skills

_____ 500 yard continuous forward stroke swim - no swim aids for time (refer to grading criteria)
_____ 15 minute tread / last 2 minutes with hands out of water (refer to grading criteria)
_____ 800 yard snorkel swim (refer to grading criteria)
_____ 100 yard inert diver rescue tow (refer to grading criteria)

Skin Diving Skills

_____ mask clearing
_____ snorkel clearing (popping & expansion)
_____ snorkel without mask (led by partner, 1 lap)
_____ fin kicks (flutter / dolphin) one length each, using mask and snorkel
_____ in-water surface dives (head first / feet first)

SCUBA Diving Skills

_____ entries (giant stride / seated or controlled entry)
_____ neutral buoyancy control (oral / power) inflation
_____ dry suit buoyancy control and emergency procedures (i.e., hose disconnect or flooding)
_____ regulator clearing (blowing / purging) and retrieval
_____ regulator without mask (led by partner, 1 lap)
_____ full face mask (removal / switch to regulator / clearing full face mask / replace full face mask)
_____ descent procedures (signal / check time & air / raise inflator hose / feet first descent / clear ears)
_____ ascent procedures (signal / check time & depth / + buoyancy / raise inflator hose / ascend @ 20 ft/min)
_____ air sharing at depth and during ascent
_____ buddy breathing at depth and during ascent
_____ emergency swimming ascent procedures (simulate out of air / signals / ascends / continuous exhaling / surfaces / inflates BC orally using bobbing technique)
_____ emergency buoyant ascent procedures (simulate out of air / signals / drops weights / ascends / continuous exhaling / surfaces / inflates BC orally using bobbing technique)
_____ weight belt (removal / replacement) on surface and bottom
_____ buoyancy control device (removal / replacement) on surface and bottom
_____ OPTIONS: Blackout Mask / Night Dive / Navigation / Confidence Obstacle Course

Performance Comments: _____

_____

Equipment Care and Storage

_____ properly disassembles equipment
_____ cleans and restores equipment properly

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FIGURE A.18.4.5(b) Basic SCUBA Skills Evaluation.

A.18.4.6(4) The 90 percent diver can be located on shore but proximal to the point of entry and immediately ready to enter the water. Typically, this is a fully dressed diver for whom the pre-entry safety check has been performed and who requires only minimal pre-entry effort — usually donning fins and face piece. His/her primary role is to enter the water and act as a backup diver should the safety diver be deployed. However, the 90 percent diver might also be required to enter the water for nonemergent reasons, such as equipment failure of a primary diver, to maintain mission continuity.

A.18.4.8(1) Dive operations involve work in an IDLH environment. To ensure safe dive operations, all divers must plan their dives to maintain an adequate reserve to manage unforeseen circumstances.

The one-third reserve should be calculated in advance for specific sizes of the cylinders used by the team by using the total volume of air, including any redundant air systems, adjusted for the rated working pressure of the cylinders associated with the breathing gas systems. From that calculation, determine the primary system pressure that would leave the diver with approximately one third the total volume in reserve. It is not the intent to calculate the reserve pressure based on the actual pressure of the cylinder at the start of the dive but always with the rated working pressure of the cylinder.

A diver equipped with only a standard aluminum cylinder 80 gets 80 ft^3 (2.27 m^3) at 3000 psi. Because there is no redundant air supply (RAS), the entire reserve one-third volume of 26.6 ft^3 (0.74 m^3) must be carried in the primary system.

(26.6 ft^3 × 3000 psi)/80 ft^3 = 1000 psi

A diver equipped with an 80 ft^3 (2.27 m^3) primary HP Steel and Pony cylinder with a working pressure of 3500 psi and 21 ft^3 (0.59 m^3) redundant air system cylinder has a total of 101 ft^3 (2.86 m^3). The diver needs to be on the surface with approximately 33.6 ft^3 (0.93 m^3) to meet the one third. Subtract the 21 ft^3 (0.59 m^3) provided in the RAS cylinder to leave 12.6 ft^3 (0.34 m^3) in the primary for the required reserve.

(12.6 ft^3 × 3500psi)/80 ft^3 = 472 psi

Even though the calculated minimum surface reserve pressure is 472 lb (214 kg), the minimum permissible breathing gas pressure is 500 psi. In this case the diver's minimum primary reserve pressure is 500 psi.

Ensuring that divers comply with the required minimum reserve pressure is often a challenge to agencies that perform public safety diving. Ensuring that divers get adequate training using the established limits, including calculating additional air required to perform the ascent and relevant safety stops, is a key element to ensuring compliance. Training should be conducted at depths and under conditions that simulate an actual rescue environment while performing mission-specific work as often as possible so that divers can set proper expectations about air consumption and exertion levels. Instances where divers violate the minimum reserve pressure should be treated as a breach of policy, and the contributing factors should be documented to prevent recurrence. The AHJ is responsible for holding divers and supervisors accountable for compliance with established limits.

A.18.4.8(3) Safe use of dive tables means precise use of nationally recognized dive tables specified for the type of dive operation undertaken. Agencies that use dive computers for managing and measuring hyperbaric exposure need to be fully educated on the algorithms used by the device to plot the diver's gas loading as computers are typically not as conservative as dive tables.

A.18.4.8(7) Some widely recognized search techniques include fan patterns, circle searches, jackstay, and drip line patterns.

A.18.4.8(8) The need to perform a complete or rapid field neuro checklist checklist *[see Figure A.18.4.8(8)]* is not limited to divers who exhibit symptoms of DCS. Divers who work in conditions that are unusually deep, cold, or arduous should also receive a structured exam regardless if they are initially symptomatic.

A.18.4.8(10) For public safety diving, the use of full-face mask regulators and voice communication tools is largely universal. These systems add enormous efficiencies and a margin of safety for divers. These systems provide the ability for surface support personnel to continuously monitor both a diver's comfort and general physiological state. The preferred method is full duplex (simultaneous bidirectional communication) to allow the respirations and comfort of the diver to be monitored continuously and is vital to ensuring the diver's safety. However, agencies should also have alternative means of communicating basic commands to divers both on the surface and while submerged. A common alternative method uses line pulls between a tethered diver and a tender to communicate general information and commands.

A.18.4.8(11) A diver running out of air for any reason is an immediately life-threatening event. Practices and tools that address this possibility are vital to the survival of public safety divers. Ideally each diver has a redundant air system, complete with a separate air source and independent delivery system. Training on associated techniques to provide buoyancy when the diver has no compressed air in his/her cylinder should also be included. *(See 3.3.107 for the definition of a redundant air system and A.3.3.107 for related annex material.)*

A.18.4.8(12) Public safety divers are exposed to a growing list of known and unknown chemical and biological contaminants. Exposure prevention is the best way to avoid potential problems. Examples of chemical exposures include those secondary to submerged vehicles, industrial chemicals, sewage runoff, and so on. Examples of biological hazards include *Pfiesteria dinoflagellates, Naegleria amoeba,* and fecal coliforms.

A.18.4.8(13) The death of a public safety diver is often associated with entanglement. Safe and effective procedures to rescue entangled divers are vital to operations and necessary to improve the overall safety of public safety diving.

A.18.4.8(14) See Chapter 11 of NFPA 472 and NFPA 473 for pre-entry and postentry monitoring. An abbreviated exam in rescue mode can consist of oral history only (e.g., level of consciousness, recent illness, injury, or medication; recent alcohol ingestion; problems incompatible with equalizing). This exam can be accomplished as the diver is dressing.

A.18.4.8(15) Many public safety dive teams assist or provide evidence work as part of their mission. These skills must be performed correctly for a complete and successful outcome.

The Rapid Field Neuro Exam

Mental Status:

1) Ask the diver to state his name, where he is, the time of day, and most recent activity.
2) Evaluate his speech for clearness and appropriateness.

Cranial Nerves:

1) Sight / Eye movements:
   a) Hold up different numbers of fingers for the diver to count.
   b) Have the diver follow your finger with his eyes while keeping his head straight. Move your finger up, down, left and right. Watch for nystagmus.
2) Facial Movements:
   a) Place your fingers at the angle of the diver's jaw and ask him to clench his teeth.
   b) Ask him to wrinkle his forehead as you smooth the skin.
   c) Instruct him to stick his tongue out and move it in all four directions.
   d) Check the diver's smile for symmetry.
3) Head / Shoulder Movement:
   a) Ask the diver to tilt his head back and swallow. Watch for his "Adams Apple" to move.
   b) Push down lightly on his shoulders, asking him to shrug.
   c) Put your hand on one side of the diver's face and ask him to push against it. Do the same with the other side, and on the forehead and back of the head.
4) Hearing:
   a) Rub your fingers together close to the diver's ears to identify the sounds he's to listen for.
   b) Ask him to close his eyes.
   c) Move your hand away from his ear and make the sound again.
   d) Continue to make the sound as you move your hand back towards the ear.
   e) Ask him to tell you when he can hear the sound again.

Sensations:

1) The objective is to evaluate the sense of light touch and make sure it's equal on both sides of the body.
2) Sensations are checked with the diver's eyes closed, pockets empty, and the diver dressed down to light clothing or bare skin.
3) Tell the diver that the light touch should feel normal and the same on both sides of his body.
4) Evaluate the body sections, checking the right and left sides at the same time. Overlap the sections slightly.
5) Run your fingers across the forehead, down the sides of the face and along the jaw line.
6) Then run your fingers down the diver's chest, abdomen, front of arms, legs and across the hands.
7) Turn him around and run your fingers down his back, buttocks, and the backs of the arms and legs.

Muscle Tone:

1) The objective is to evaluate muscle tone and determine that it's equal on both sides of the body.
2) Have the diver bend his arms so that his hands meet in the center of his chest. With his arms bent have him bring his elbows up level with his shoulders (or demonstrate the move and say "Do this").
3) Tell him to push against you as you push his elbows up, then down, and pull his hands away from his chest and push them back.
4) To evaluate grip strength in each hand, ask him to squeeze two of your fingers.
5) Leg evaluation: With diver sitting, evaluate both legs. Put your hand on his thigh and ask him to pick the leg up against resistance. Then put your hand under the thigh and ask him to pull down. Put your hands on the front of his lower legs and ask him to push out. Then put your hands behind the legs and ask him to pull back.
6) Leg evaluation: With diver laying, evaluate both legs. Ask him to do a straight leg raise as you lightly push down on the leg. Have him bend the leg up and push against your hand as you hold his foot.
7) Foot evaluation: Have the diver pull his feet up as you push them down and then push against your hands as if pushing on a pedal.

Balance and Coordination:

1) The objective is to make sure that the diver can hold himself upright, move without being off balance and that he has normal hand/eye coordination. Protect the diver from falling.
2) Romberg Test: Have the diver stand upright with his eyes closed, feet together and arms outstretched in front of him. Ask him to stand this way for several seconds. Then ask him to walk in place, bringing his knees up. Eyes remain closed.
3) Heel-shin slide: If the diver is laying down, have him place the heel of one foot on the opposite leg, just below the knee. Then have him run the heel down his shin to the ankle. Do both legs.
4) Alternating hand movements: Have the diver alternately touch his index finger to his nose and then to your finger, held about 18" (.5 meters) away from his face. Repeat the movement several times and test both hands.

Vital Signs (If trained and equipped):

1) The objective is to evaluate the findings in the Rapid Field Neuro Exam with the baseline vitals.
2) Blood pressure
3) Pulse
4) Respirations

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FIGURE A.18.4.8(8) Field Neuro Check Sheet. ***(Source: Dive Rescue International.)***

Rapid Field Neuro Checksheet

Diver's Name: _____ **Name of Examiner:** _____

Date: _____ **Initial Complaint:** _____

Time									Notes
Mental Status: Do they know:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Their name?									
2) Where they are?									
3) Time of day?									
4) Most recent activity?									
5) Speech is clear, correct?									
Sight:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Correctly counts fingers?									
2) Vision clear?									
Eye Movements:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Move all four directions?									
2) Nystagmus absent?									
Facial Movements?	Yes	No	Yes	No	Yes	No	Yes	No	
1) Teeth clench OK?									
2) Able to wrinkle forehead?									
3) Tongue moves all directions?									
4) Smile symmetrical?									
Head/Shoulder Movements:	Yes	No	Yes	No	Yes	No	Yes	No	
1) "Adams Apple" moves?									
2) Shoulder shrug normal, equal?									
3) Head movements normal, equal?									
Hearing:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Normal for that diver?									
2) Equal both ears?									
Sensations: Present, normal and Symmetrical across?	Yes	No	Yes	No	Yes	No	Yes	No	
1) Face									
2) Chest									
3) Abdomen									
4) Arms (front)									
5) Hands									
6) Legs (front)									
7) Feet									
8) Back									
9) Arms (back)									
10) Buttocks									
11) Legs (back)									
Muscle Tone: Present, normal and symmetrical for:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Arms									
2) Hand grips									
3) Legs									
4) Feet									
Balance and Coordination:	Yes	No	Yes	No	Yes	No	Yes	No	
1) Romberg OK?									
2) If Supine: Heel-shin slide OK?									
3) Alternating hand movements OK?									
Vital Signs:									
1) Blood pressure									
2) Pulse									
3) Respirations									

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FIGURE A.18.4.8(8) ***Continued***

A.18.4.8(16) The dive emergency response plan is a tool developed by the agency as a resource for the dive supervisor and tender in the event one of the agency's divers is missing, ill, or injured. It should be readily available at the dive site for all operations where divers are committed to the water and should include the following:

(1) Contact information for local medical providers who deal with hyperbaric emergencies
(2) A copy of the agency's dive policy
(3) Pre-entry check sheets
(4) Pre- and postdive medical evaluation criteria
(5) Action plan for projected emergencies, such as missing diver, and so forth

A.18.4.8(18) See Figure A.18.4.8(18).

A.18.4.9 Ideally, this exam is conducted by a board-certified hyperbaric physician.

A.18.4.12 It is the intent that divers in the organization perform approximately one dive per quarter, performing functions in the scope of team work and filling roles typically used when deploying in accordance with the team's operating guidelines or best practices. This would be in addition to dives focused on personal skills or comfort in the water. Dives performed at actual incidents can count toward the required four annual dives.

A.19.2.3(2) The assessment phase includes an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue. Consideration should be given to the need for dive rescue early in the assessment phase. The best intended surface rescue could eventually require dive capability.

A.19.2.3(3) See A.4.2.5.

A.19.2.3(4) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.19.2.3(5) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.19.2.3(6) General hazards associated with water search and rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(1) *Utilities.* Control of the utilities in and around a water incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment for them to operate in and to ensure the safety of victims. The following utilities should be considered when providing training:
    (a) Electrical services (primary and secondary)
    (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
    (c) Water/steam
    (d) Sanitary systems
    (e) Communications
    (f) Secondary service systems (such as compressed, medical, or industrial gases)
(2) *Hazardous Materials.* Water incident sites might include various materials unique to a site that, when released during a search and rescue operation, could pose a hazard to victims and responders. The AHJ should provide its members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.
(3) *Personal Hazards.* At the site of any water incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train its members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure members' safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.
(4) *Confined Space.* Some water incident sites necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to its members in confined space rescue.
(5) *Hazards That Are Immediately Dangerous to Life and Health.* These hazards include swift water with currents exceeding those in which a person or watercraft can safely and effectively operate.
(6) *Other Hazards.* There are numerous other hazards associated with water search and rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide its members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.
(7) *General Area.* The general area around a water incident site is the entire area around a search and rescue site. Any member operating within the vicinity of the water's edge can accidentally enter the hazard zone. PPE should be utilized accordingly. Making the general area safe includes, but is not necessarily limited to, the following:
    (a) Controlling/limiting access to the area by unnecessary personnel
    (b) Identifying hazards and removing or reducing their impact
    (c) Using personal flotation devices (PFDs) and other PPE

A.20.2.3(2) The assessment phase includes an evaluation of the subject's condition and the subject's ability to assist in his or her own rescue. Consideration should be given to the need for dive rescue early in the assessment phase. The best intended surface rescue could eventually require dive capability.

A.20.2.3(3) See A.4.2.5.

A.20.2.3(4) The emergency response system includes, but is not limited to, operations- and technician-level organizations capable of responding to various types of search and rescue incidents, as well as local, state, and national resources.

A.20.2.3(5) These procedures should include the process of achieving and maintaining control of the site and the perimeter. This might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

Dive Checklist/Operations Worksheet

Primary Diver	Safety Diver	90% Diver
Tender _____	Tender _____	Tender _____
Diver _____	Diver _____	Diver _____
Primary Diver	**Safety Diver**	**90% Diver**
_____ Hood	_____ Hood	_____ Hood
_____ Mask	_____ Mask	_____ Mask
_____ Full face mask	_____ Full face mask	_____ Full face mask
_____ Wet/dry suit	_____ Wet/dry suit	_____ Wet/dry suit
_____ Harness/carabiner locked	_____ Harness/carabiner locked	_____ Harness/carabiner locked
_____ Quick release snap shackle	_____ Quick release snap shackle	_____ Quick release snap shackle
_____ Buoyancy control device	_____ Buoyancy control device	_____ Buoyancy control device
_____ Regulator	_____ Regulator	_____ Regulator
_____ Depth gauge/pressure gauge	_____ Depth gauge/pressure gauge	_____ Depth gauge/pressure gauge
_____ Octopus/alternate air source	_____ Octopus/alternate air source	_____ Octopus/alternate air source
_____ Compass	_____ Compass	_____ Compass
_____ Gloves	_____ Gloves	_____ Gloves
_____ 2 cutting tools	_____ 2 cutting tools	_____ 2 cutting tools
_____ Weight belt _____ lb	_____ Weight belt _____ lb	_____ Weight belt _____ lb
_____ Ankle weights	_____ Ankle weights	_____ Ankle weights
_____ Fins	_____ Fins	_____ Fins
_____ Review objective	_____ Review objective	_____ Review objective
_____ Establish initial overlap in pattern	_____ Establish initial overlap in pattern	_____ Establish initial overlap in pattern
_____ Review found object protocol	_____ Review found object protocol	_____ Review found object protocol
_____ Comm check/review line signals	_____ Comm check/review line signals	_____ Comm check/review line signals
_____ Review diver in distress protocol	_____ Review diver in distress protocol	_____ Review diver in distress protocol
_____ Review emergency procedures	_____ Review emergency procedures	_____ Review emergency procedures
Start tank pressure _____ psi	Start tank pressure _____ psi	Start tank pressure _____ psi
Start dive time: _____	Start dive time: _____	Start dive time: _____
MAX. DEPTH FOR DIVE: _____	MAX. DEPTH FOR DIVE: _____	MAX. DEPTH FOR DIVE: _____
Tank pressure _____ psi 5 minutes	Tank pressure _____ psi 5 minutes	Tank pressure _____ psi 5 minutes
Tank pressure _____ psi ____ minutes	Tank pressure _____ psi ____ minutes	Tank pressure _____ psi ____ minutes
Tank pressure _____ psi ____ minutes	Tank pressure _____ psi ____ minutes	Tank pressure _____ psi ____ minutes
Ending tank pressure _____ psi	Ending tank pressure _____ psi	Ending tank pressure _____ psi
END DIVE TIME: _____	END DIVE TIME: _____	END DIVE TIME: _____
MAX. DEPTH: _____	MAX. DEPTH: _____	MAX. DEPTH: _____
Feet/total bottom time: _____ minutes	Feet/total bottom time: _____ minutes	Feet/total bottom time: _____ minutes
RAPID FIELD NEURO Exam results: POSITIVE/NEGATIVE	RAPID FIELD NEURO Exam results: POSITIVE/NEGATIVE	RAPID FIELD NEURO Exam results: POSITIVE/NEGATIVE
(Attach copy of check sheet to this form)	(Attach copy of check sheet to this form)	(Attach copy of check sheet to this form)
TENDER SIGNATURE	TENDER SIGNATURE	TENDER SIGNATURE
DIVE SUPERVISOR SIGNATURE	DIVE SUPERVISOR SIGNATURE	DIVE SUPERVISOR SIGNATURE

FIGURE A.18.4.8(18) Dive Checklist. *(Source: Dive Rescue International.)*

A.20.2.3(6) General hazards associated with water search and rescue operations can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members.

(1) *Utilities.* Control of the utilities in and around a water incident is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment for them to operate in and to ensure the safety of victims. The following utilities should be considered when providing training:
   (1) Electrical services (primary and secondary)
   (2) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (3) Water/steam
   (4) Sanitary systems
   (5) Communications
   (6) Secondary service systems (such as compressed, medical, or industrial gases)

(2) *Hazardous Materials.* Water incident sites might include various materials unique to a site that, when released during a search and rescue operation, could pose a hazard to victims and responders. The AHJ should provide its members with training in the recognition of potential hazardous material releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.

(3) *Personal Hazards.* At the site of any water incident, there are many dangers that pose personal injury hazards to the responders. The AHJ should train its members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure members' safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(4) *Confined Space.* Some water incident sites necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide training to its members in confined space rescue.

(5) *Hazards That Are Immediately Dangerous to Life and Health.* These hazards include swift water with currents exceeding those in which a person or watercraft can safely and effectively operate.

(6) *Other Hazards.* There are numerous other hazards associated with water search and rescue operations. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide its members with training and awareness of these other hazards to allow them to perform search and rescue operations safely and effectively.

(7) *General Area.* The general area around a water incident site is the entire area around a search and rescue site. Any member operating within the vicinity of the water's edge can accidentally enter the hazard zone. PPE should be utilized accordingly. Making the general area safe includes, but is not necessarily limited to, the following:
   (a) Controlling/limiting access to the area by unnecessary personnel
   (b) Identifying hazards and removing or reducing their impact
   (c) Using personal flotation devices (PFDs) and other PPE

A.20.2.3(7) Refer to Figure A.16.2.3(7) for an example of a rescue/recovery decision matrix tool.

A.21.1.2 For the purposes of this chapter, rescue watercraft include human-powered and motorized vessels and craft that are intended to carry rescuers and victims. It does not include rescue devices such as swim aids, paddle boards, and rescue boards, which might accommodate a victim but are not typically classified as vessels or watercraft.

A.21.1.3 The intent of 21.1.3 is that the capability for watercraft rescue as outlined in this section be structured to meet all water or weather conditions that might reasonably be encountered as part of the agency's mission. For those agencies that use watercraft to support multiple missions, the most challenging or demanding conditions should be used as the baseline. If the AHJ cannot meet the needs of all missions with a single watercraft type, then watercraft suitable for each specific mission should be used.

A.21.3.3 For the purposes of this chapter, a rescue watercraft includes human-powered and motorized vessels and craft that are intended to carry rescuers and victims. It is not intended to include rescue devices such as swim aids, paddle boards, and rescue boards, which might accommodate a victim but are not typically classified as vessels or watercraft.

The intent of 21.3.3 is to ensure that members responsible for actually operating the watercraft or its equipment and systems are provided training to perform the related functions under conditions that are as similar as possible to the most demanding potential work environment. This requirement does not apply to rescuers aboard the watercraft who are using the craft as a work platform to fulfill the rescue mission and whose primary function is exclusive of operating the vessel or its systems.

A.21.3.4 For the purposes of this chapter, the PPE is intended to protect a rescuer from the effects of accidental immersion and help facilitate timely removal from the water and ensure their survival. The term *hazard zone* as it is used here is intended to describe areas where the combination of water depth and the likelihood for accidental immersion pose a risk to the responder. Organizations performing watercraft-based rescue functions at the operations level typically are engaged in tasks that increase their exposure to the water and the potential for accidental immersion. Additionally, performing tasks in this environment might inhibit an individual's ability to remain steady or otherwise distract him/her from recognizing conditions that pose a risk for accidental immersion.

Passengers or crew who are in a cabin or inside the confines of an approved railing system and who have no duties that might expose them to immersion risk will not be required to wear a PFD. If conditions change, however, a PFD should be immediately available.

Some circumstances require all crewmembers to wear a PFD and a water rescue helmet for protection from impact and/or rapid immersion. Those circumstances include breaking or standing waves, swift water, and operating watercraft at risk for rapid capsize due to waves or obstacles.

It is recognized that additional PPE might be required based on the task the rescuer has been assigned, environmental conditions, physical hazards, and other factors that might pose a risk to the responder.

A.21.3.4(3) Visible signaling devices include reflective striping, strobes, flashlights, and other light sources as required by the AHJ.

A.21.3.5 Members of an organization at the operations level are expected to perform duties typically described as those of a deckhand or crewmember. Capabilities of organizations at this level include manipulating lines and operating pumps, capstans, radios, and any watercraft-specific rescue equipment. The primary scope of work at this level is supporting the function of the watercraft as a search and rescue tool under the direction of a vessel operator.

A.21.3.5(6) Communication methods might vary but could include hand signals, radios, lights, or audible devices. In many cases where watercraft operations and vessel traffic are common, the use of marine VHF radios with predetermined channels for specific purposes is standard practice.

A.21.3.5(7) Towing procedures can vary significantly depending on the size of the rescue craft and the vessel to be towed. Considerations also include water conditions, weather, the number of occupants, and the nature of the incident. Use of improper methods or undertaking a tow with an improperly sized vessel can pose a risk of swamping or capsizing either or both vessels. Crewmembers should be well-versed in how to connect the watercraft so the tow is accomplished safely. They should also recognize conditions when the tow should be aborted.

A.21.3.5(8) The need to deploy technician-level rescuers will vary from agency to agency based on available resources. These might include divers and/or surface water rescue technicians. Of primary importance is to ensure the watercraft and its systems pose no hazard to rescuers who are moving back and forth from the craft to the water or to rescuers who are in the water.

A.21.3.5(9) Methods for approaching and contacting waterbound subjects should include procedures for maintaining contact with or sight of the subject on approach, ensuring the watercraft or its systems do not pose a hazard to the subject or the rescuers performing the recovery, and preventing the recovery operation from compromising the stability of the watercraft.

A.21.3.5(11) Crew overboard (COB) procedures will vary by vessel and water conditions. Typically all will include maintaining visual contact with the subject, alerting the vessel operator and other crewmembers, and deploying a flotation aid or marker. In most cases, the boat operator takes specific predetermined action to maneuver the craft to recover the subject depending on where from the vessel he/she fell. However in some cases, such as swift water, maneuvering the watercraft to recover the subject might not be an option. Other resources, such as another craft or a downstream safety team, might have to be deployed.

A.21.4.2 For the purposes of this chapter, a rescue watercraft includes human-powered and motorized vessels and craft that are intended to carry rescuers and victims. It is not intended to include rescue devices such as swim aids, paddle boards, and rescue boards, which might accommodate a victim but are not typically classified as vessels or watercraft.

The intent of this requirement is to ensure that members responsible for operating the watercraft or its equipment and systems are provided training to perform the related functions under conditions that are as similar as possible to the most demanding potential work environment. This requirement does not apply to rescuers aboard the watercraft who are using the craft as a work platform to fulfill the rescue mission and whose primary function is exclusive of operating the vessel or its systems.

A.21.4.3 Members of an organization at the technician level are expected to perform duties typically described as those of a boat operator. Capabilities of organizations at this level include navigating, operating the controls, communicating with crewmembers, and other related duties.

A.21.4.3(1) Towing procedures can vary significantly depending on the size of the rescue craft and the vessel to be towed. Considerations also include water conditions, weather, the number of occupants, and the nature of the incident. Use of improper methods or undertaking a tow with an improperly sized vessel can pose a risk of swamping or capsizing either or both vessels. Crewmembers should be well-versed in how to connect the watercraft so the tow is accomplished safely. They should also recognize conditions when the tow should be aborted.

A.21.4.3(2) The need to deploy technician-level rescuers will vary from agency to agency based on available resources. These might include divers and/or surface water rescue technicians. Of primary importance is to ensure the watercraft and its systems pose no hazard to rescuers who are moving back and forth from the craft to the water or to rescuers who are in the water.

A.21.4.3(3) Methods for approaching and contacting waterbound subjects should include procedures for maintaining contact with or sight of the subject on approach, ensuring the watercraft or its systems do not pose a hazard to the subject or the rescuers performing the recovery, and preventing the recovery operation from compromising the stability of the watercraft.

A.21.4.3(5) Crew overboard (COB) procedures will vary by vessel and water conditions. Typically all will include maintaining visual contact with the subject, alerting the vessel operator and other crewmembers, and deploying a flotation aid or marker. In most cases the boat operator takes specific predetermined action to maneuver the craft to recover the subject depending on where from the vessel he/she fell. However in some cases, such as swift water, maneuvering the watercraft to recover the subject might not be an option. Other resources, such as another craft or a downstream safety team, might have to be deployed.

A.22.2.2(2) Emergency response systems for flood incidents should be suitable for the scale and expected duration of a flood incident. It could require multiple agencies to engage and work cooperatively to provide a range of capabilities that might include, but not be limited to, the following:

(1) Obtaining environmental information about the flood and its sources
(2) Warning and informing members of the public
(3) Evacuating affected person

(4) Managing vulnerable persons
(5) Dealing with mass casualties
(6) Arranging mass care
(7) Arranging mass decontamination
(8) Dealing with mass fatalities
(9) Arranging domestic animal rescue
(10) Arranging wide area searches for missing persons
(11) Assessing infrastructure impacts
(12) Evaluating public health issues
(13) Evaluating utilities

The geographic scale of the incident might require suitable scaled emergency response systems at the following levels:

(1) Local, municipal, county
(2) Regional/mutual
(3) State
(4) Federal

A.22.2.2(3) Incident management systems for flood incidents need to be scalable to meet the requirements of flood incidents that might extend across political and jurisdictional boundaries. Responder safety is a key priority, and the nature of flooding incidents often requires responders to operate remotely for extended periods.

A.22.2.2(4) Hazards present in floods include water-related hazards, but the scale and nature of the hazards might be compounded by the flood. Additional hazards can also be present depending on the environment.

A.22.2.2(5) Flood types, usually classified by their source and pathway, include the following:

(1) Fluvial (river)
(2) Pluvial (rainfall)/surface water
(3) Groundwater
(4) Storm surge/tide surge
(5) Urban
(6) Snow-melt
(7) Man-made dam failures

Flood types are also categorized by the speed of the event:

(1) Flash floods (typically short notice river- or rain-related flood events)
(2) Slow rise events (some prewarning provided)

A.22.2.2(6) Flooding incidents are typically characterized by phases, which include the following:

(1) Preflood phase (no flooding yet)
(2) Rapid water rise phase
(3) Slow water rise phase
(4) Static water level phase
(5) Receding water phase
(6) Termination and recovery phase

These phases can vary in duration, and each phase might require different capabilities to operate safely.

A.22.2.2(9) Floods have long-term consequences for those affected. Responding organizations should be aware of the impact — often for extended periods — on the following areas:

(1) Social
(2) Economic
(3) Political

A.22.2.2(10) Search marking systems need to be usable in the flood environment, and the structural collapse marking systems might not be easy to implement for some of the following reasons:

(1) Varying water levels can hide markings during follow-up search activities.
(2) Paint- and poster-based systems can be difficult to apply reliably in wet conditions or to wet surfaces.
(3) Buildings and structures might be re-occupied after search activities, and marking systems can adversely affect the cost to return the building to normal use.

A.22.3.5 Flood incidents will often include a range of water environments, from shallow still water to high-energy, high-volume water environments.

A.22.3.7(3) Flood search and rescue incidents at the operations level might require a range of different types of watercraft and capabilities, but their scope of use should be limited to lower risk and still water environments with simple techniques. Helm- and crewmembers might be assigned a range of flood-related tasks, and they should be aware of the impact of these tasks on boat and crew safety.

A.22.3.7(4) In flood-affected areas, the usual signs, aids, and routes used to move through the area might be difficult or impossible to use. Responders should be able to navigate and report their position using a range of aids such as maps, aerial photographs, and GPS systems.

A.23.1.1 Non-standard tower structures include variations such as water towers, wind turbines, concrete towers, silos, flare stacks, radar structures, wooden poles, portable towers, tower cranes, and so forth.

A.23.2.1 "Timely" in this case is not intended to refer to the kind of response capability that might be achieved through on-site, standby or co-worker assisted rescue, but is intended to emphasize that an organization who claims response capability should be able to get en-route with appropriate equipment and personnel without delay. In other words, it shouldn't take an extra 30 minutes after the initial callout to activate the Tower Response Unit.

A.23.2.2 Training should address the process of achieving and maintaining control of the site and the perimeter, whether at awareness, operations, or technician level. This control might include management of all civilian and nonemergency personnel and establishment of operational zones and site security.

A.23.2.3 Hazards associated with tower rescue operations can vary widely depending on the type and purpose of the tower, age, and structural integrity of the tower, location of the tower, environmental conditions, and other factors. The AHJ should consider the following potential hazards and, to help provide for their safety, ensure that members have the ability to recognize potential hazards that they could encounter:

(1) *Type of Structure.* Towers can be guyed, self-supporting, monopole, or non-standard structures. In any case, condition of all connections, including foundation and anchor point(s), are key to safety. Rescuers should be trained to examine the tower for any condition(s) that might compromise its structural integrity.
(2) *Environmental Hazards.* Depending on the specific environment, there are many dangers that pose hazards to responders. Responders can be exposed to such things as insect bites and stings, poisonous plants, exposure in ju-

ries (cold and heat), lightning, sunburn, dangerous wildlife, and so forth. Special care should be taken when responding to towers in remote or wilderness locations.

(3) *Purpose of Tower.* Towers can be used to support communications equipment, electrical lines, or other things. Responders should pay special attention to what equipment the tower supports and what specific additional hazards might exist as a result, including electrical hazards (including inductive current hazards associated with metal structures on or near AM broadcast towers), EMF radiation, and so forth.

A.23.2.3.1 Tower incidents involve unique potential hazards and circumstances, and responders who might be exposed to such an environment should first acquire specialized training directly from a competent tower trainer who is knowledgeable and experienced in the hazards and access methods specific to towers.

A.23.2.5 Tower rescue personnel can be exposed to various electrical hazards such as the following:

(1) Inadvertent re-energization of transmission lines through contact with a live line
(2) Electrical relay cycling due to resistive load variations
(3) Induced voltage from parallel lines

Responders should work closely with the utilities involved to be made aware of, and to mitigate, these and other hazards.

A.23.3.1.2 Significant exposure hazards aside from those presented by a fall could exist to rescuers as a result of work in close proximity to tower structures and components. These can include, but are not limited to, non-ionizing radiation (e.g., EMF and RF) energy as well as mechanical and electrical power sources. Organizations operating at the Awareness level should be adequately taught to recognize and avoid these types of hazards.

Various types of non-ionizing radiation can be hazardous to humans in different ways. Near ultraviolet, visible light, infrared, microwave, radio waves, and low-frequency RF (longwave) are all examples of non-ionizing radiation. Far ultraviolet light, X-rays, gamma-rays, and all particle radiation from radioactive decay are all considered to be ionizing. Non-ionizing radiation poses a potential threat to rescuers from thermal burns and irreversible tissue damage, which might not be felt or recognized until after damage occurs.

Awareness level rescues can be performed by means such as ladders or aerial devices commonly used by the organization. Special training is required for use of these methods.

A.23.3.2(7) Some of the hazards associated with tower emergencies can be found in the Job Hazard Analysis and can include:

(1) Site access
(2) Awareness and adherence to signage (electrical, RF, etc.)
(3) Adherence to the Site Work Plan (if site workers have one)
(4) Type of tower structure
(5) Structural integrity of the tower
(6) Guy wires
(7) Gates and fences surrounding the tower
(8) Buildings on site (electrical, storage, etc.)
(9) Availability of climbing path (ladder, pegs, or structure)
(10) Climb path obstructions
(11) Ground obstructions (open pits, ditches, vats, tanks, and other hazards)
(12) Stored materials (stacked steel, concrete, lumber, and barrels)
(13) Dangerous Goods and/or Hazardous Materials (DGHM) (solvents, fuels, and oils)
(14) Cranes, gin poles, and other machinery
(15) Toxic plant/animal hazards
(16) Biohazards (bacteria, viruses, or fungi)
(17) Environmental hazards (heat, cold, high winds, rain, snow, or sleet)
(18) Radio Frequency (RF) hazards (use of an RF monitor at all times)
(19) Electrical hazards
(20) Lack of familiarity with safety equipment and tools used by tower workers
(21) Wet paint

A.23.4.3 A plan should be devised in advance for procurement of additional, more experienced, specialized, or highly trained resources.

A.23.4.3(1) The size-up should include, but not be limited to, the initial and continuous evaluation of the following:

(1) Scope and magnitude of the incident, including whether it is a rescue or recovery operation
(2) Assessment of time required
(3) Assessment of staffing needs
(4) Specific environmental factors involved
(5) Integrity and stability of the environment involved
(6) Number of known/potential victims
(7) Weather (current and forecast)
(8) Urgency (based on the type of known/potential victims)
(9) Available/necessary resources
(10) Information about the physical and mental status of the subject, including whether the subject is authorized to be on the tower

A.23.4.3(2) This includes ensuring 100 percent fall protection at all times.

A.23.4.3(4) Ongoing assessment of hazards should be performed during the course of the rescue. Changing conditions can have a profound effect on hazards such as corrosion, foundation, fasteners, anchor bolts, grounding, guy wires, and weep holes. In addition, RF and electrical hazards can change over time.

A.23.4.3(5) Resources can include, but are not limited to, the following:

(1) Tower owners/operators
(2) Installed equipment owners/operators
(3) Helicopter short haul rescue resources
(4) Crane equipment
(5) Rope rescue specialists
(6) Telecommunications/RF specialists
(7) Electrical hazard/EMF specialists
(8) Trench rescue specialists
(9) Vehicle/machinery rescue specialists
(10) Tower maintenance companies/technicians
(11) Emergency incident management teams
(12) Lightning detection equipment

A.23.4.3(13) The ability to discern limitations in accessing and/or evacuating should be based on the following:

(1) Individual and team expertise
(2) Qualified personnel available
(3) Ability to communicate from the location of the subject
(4) Anticipated staffing and time

A.23.4.4(4) Rescuers should demonstrate the ability to connect energy absorbing lanyards to the tower and to their harness D-Ring, use energy absorbers for fall arrest, limit free fall, reduce swing fall, protect lanyards from abrasive or other damaging surfaces, calculate clearance requirements, and describe common hazards and mistakes.

A.23.4.4(5) Tower rescuers should demonstrate the ability to properly connect positioning lanyards to the tower and to their harness D-Ring, use lanyards for positioning, limit fall distance, reduce swing fall, protect lanyards from abrasive or other damaging surfaces, calculate clearance requirements, maintain 100 percent connection during transfers, and describe common hazards and mistakes with these devices.

A.23.4.4(6) Tower rescuers should demonstrate the ability to use properly installed SRL that is connected to an overhead anchorage connector, climb up and down the tower structure while connected to a self retracting lifeline, descend rope while connected to a self retracting lifeline, calculate and maintain required clearances, and describe common hazards and mistakes with these devices.

A.23.4.4(7) Tower rescuers should demonstrate the ability to analyze and use a properly installed vertical lifeline for fall arrest and for positioning, select and install an appropriate rope grab on a lifeline, ascend and descend a ladder while connected to a vertical lifeline and rope grab, park a rope grab, calculate and maintain required clearances, and describe common hazards and mistakes with these devices.

A.23.4.4(8) Tower rescuers should demonstrate the ability to analyze and use a cable-type ladder climbing system as well as a vertical-rail type ladder climbing system. They shall demonstrate the ability to select an appropriate fall arrester for a given system, inspect and install the fall arrester on the host cable or rail, ascend and descend while connected to a ladder climbing safety system, prevent line entanglement, maintain 100 percent connection during transitions, calculate and maintain required clearances, and describe common hazards and mistakes with these devices.

A.23.4.4(9) Tower rescuers should demonstrate the use of a pre-climb checklist process to include review of the site JHA before climbing, plan a climb, select appropriate fall protection for a given climb, consider the safest route for a climb, assemble necessary equipment, visually assess the structure, assess the weather, and perform equipment inspections.

A.23.4.4(10) Tower rescuers should demonstrate the ability to climb a ladder that is mounted to a tower, as well as the ability to climb tower pegs. It should be demonstrated that they are able to climb under control, climb within their ability, always maintain three points of contact, rest during a climb, use skeletal climbing techniques (rather than muscle), maintain 100 percent tie-off during ascent and descent, and maneuvering within 6 ft of a fall hazard.

A.23.4.4(12) Rescuers should demonstrate the ability to preplan rescue for a given tower site, as well as the ability to perform a rescue that has been preplanned. This includes rigging with consideration to the tower structure and safely accessing an incapacitated subject per the preplan. It also includes working within a preplan to connect to and transfer an incapacitated subject to a rescue system, releasing a subject from different types of fall protection (including vertical lifeline, SRL, force absorbing lanyard, and positioning lanyard), raising the subject at least 10 ft, lowering a subject to ground from a position at least 50 ft above grade, and keeping the subject away from the structure during lowering.

A.23.5.1 Members of an organization at the technician level should be adept and experienced at every skill required of subordinate personnel. Technician-level organizations should have the capability to address any potential operation that falls within their jurisdiction. To accomplish this, members of these organizations should be personally adept at wilderness skills, travel, and operations in the wilderness setting.

A.23.5.3 Such an operational plan should be based on the hazard identification and risk assessment performed according to Section 4.2, available resources, environmental influences and conditions, and the urgency of the situation. The implemented plan should involve planning techniques including, but not necessarily limited to, the following:

(1) Determining the urgency of the incident
(2) Developing a subject profile
(3) Designing, developing, and establishing appropriate rescue strategy and tactics
(4) Sourcing and securing the necessary resources
(5) Considering the effects of prolonged suspension on both subject and rescuer(s)
(6) Demobilizing personnel and facilities
(7) Documenting the incident properly

A.23.5.3(4) Non-standard anchorages are any anchorage that is not specifically designed and specified as an anchorage. Rescuers operating at the technician level must be capable of effectively assessing available appurtenances on different types of towers for use as anchorages.

A.23.5.3(6) The rescuer must be capable of climbing the structure of the tower itself, without benefit of a ladder. In addition, the rescuer must also be able to effectively protect himself or herself from a fall using a type of fall protection that is carried (for example, twin lanyards).

A.23.5.3(7)(c) Horizontal manipulation can be required where it is necessary to evacuate a subject from a tower with a cross-arm or to protect a subject from a hazard that exists in the vertical path.

A.23.5.4(1) Rescuers should demonstrate the ability to properly use an energy absorbing lanyard for safety while ascending/descending/traversing a tower.

A.23.5.4(2) Tower rescuers should demonstrate the ability to properly assemble and install a horizontal lifeline (including tensioning) and to supervise another's use of a horizontal lifeline.

A.23.5.4(3) Tower rescuers within the technician level organization should demonstrate the ability to climb the tower structure (not just a ladder) under control and within their ability, always maintain three points of contact, rest during a climb, use skeletal climbing techniques (rather than muscle), maintain 100 percent tie-off during ascent and descent, and maneuver within 6 ft of a fall hazard.

A.23.5.4(5) Rescuers should demonstrate the ability to quickly and efficiently determine appropriate rescue methods for a tower for which rescue has not been preplanned. This includes selection of rigging/rescue techniques appropriate to the tower structure, selecting and rigging anchorages specific to a tower, safely accessing an incapacitated subject, connecting to and transferring an incapacitated subject to a rescue system, releasing a subject from different types of fall protection (including vertical lifeline, SRL, force absorbing lanyard, and positioning lanyard), raising the subject at least 10 ft (3.1 m), lowering a subject to ground from a position at least 50 ft (15.2 m) above grade, and keeping the subject away from the structure during lowering.

Annex B Sloping and Benching

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 General. The material in this annex describes and defines sloping and benching as used in this standard and is excerpted from Appendix B (Excavations, Sloping and Benching) of 29 CFR 1926, Subpart P.

(1) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in 1926.652(b)(2).

(2) *Definitions.*

(a) *Actual slope* means the slope to which an excavation face is excavated.

(b) *Distress* means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and ravelling, e.g., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

(c) *Maximum allowable slope* means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

(d) *Short term exposure* means a period of time less than or equal to 24 hours that an excavation is open.

(3) *Requirements.*

(a) *Soil Classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(b) *Maximum Allowable Slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B.1 of this appendix.

(c) *Actual Slope.*

i. The actual slope shall not be steeper than the maximum allowable slope.

ii. The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½ H:1V) less steep than the maximum allowable slope.

iii. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with 1926.651(i).

(d) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B.1.1.1(a) through Figure B.1.1.3(c).

B.1.1 Excavations Made in Type A Soil.

B.1.1.1 All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1. *[See Figure B.1.1.1(a).]*

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1. [See Figure B.1.1.1(b).]

B.1.1.2 All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows: *[See Figure B.1.1.2(a) and Figure B.1.1.2(b).]*

B.1.1.3 All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet. *[See Figure B.1.1.3(a).]*

All excavations more than 8 feet but not more than 12 feet in depth with unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet. *[See Figure B.1.1.3(b).]*

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side. *[See Figure B.1.1.3(c).]*

B.1.1.4 All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under 1926.652(b).

Table B.1 Maximum Allowable Slopes

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 6.1 m (20 ft) Deep[2]
Stable rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1 (34 degrees)

[1]Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

[2] Sloping or benching for excavations greater than 6.1 m (20 ft) deep shall be designed by a registered professional engineer.

[3] A short-term maximum allowable slope of ½H:1V (63 degrees) is allowed in excavations in Type A soil that are 3.67 m (12 ft) or less in depth. Short-term maximum allowable slopes for excavations greater than 3.67 m (12 ft) in depth shall be ¾H:1V (53 degrees).

Source: 29 CFR 1926, Subpart P, Appendix B, Table B-1.

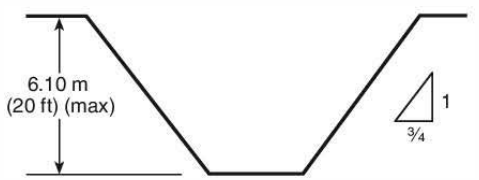


FIGURE B.1.1.1(a) Simple Slope — General. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.1(a)]*

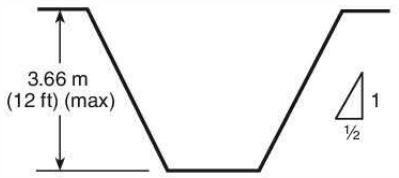


FIGURE B.1.1.1(b) Simple Slope — Short Term. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.1(b)]*

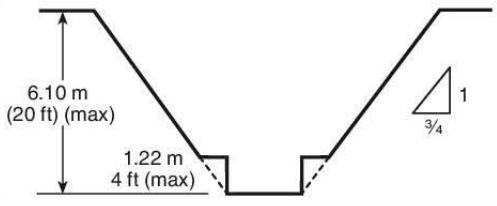


FIGURE B.1.1.2(a) Simple Bench. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.1(c)]*

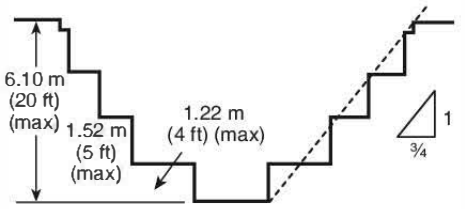


FIGURE B.1.1.2(b) Multiple Bench. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.2(d)]*

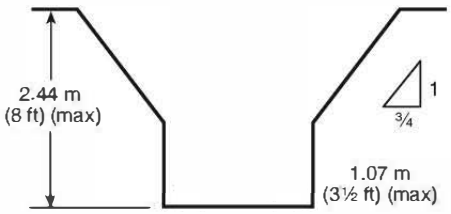


FIGURE B.1.1.3(a) Unsupported Vertically Sided Lower Portion — Maximum 8 Feet in Depth. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.3(e)]*

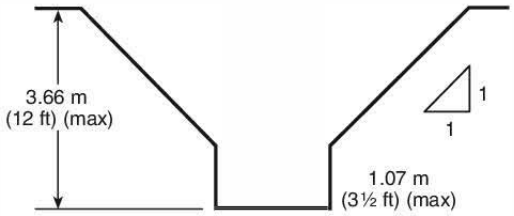


FIGURE B.1.1.3(b) Unsupported Vertically Sided Lower Portion — Maximum 12 Feet in Depth. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.3(f)]*

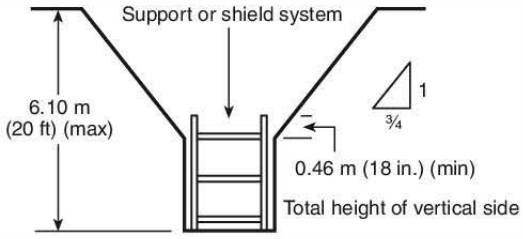


FIGURE B.1.1.3(c) Supported or Shielded Vertically Sided Lower Portion. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.1.3(g)]*

B.1.2 Excavations Made in Type B Soil.

B.1.2.1 All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1. *(See Figure B.1.2.1.)*

B.1.2.2 All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows: *[See Figure B.1.2.2(a) and Figure B.1.2.2(b).]*

B.1.2.3 All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1. *(See Figure B.1.2.3.)*

B.1.2.4 All other sloped excavations shall be in accordance with the other options permitted in 1926.652(b).

B.1.3 Excavations Made in Type C Soil.

B.1.3.1 All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1. *(See Figure B.1.3.1.)*

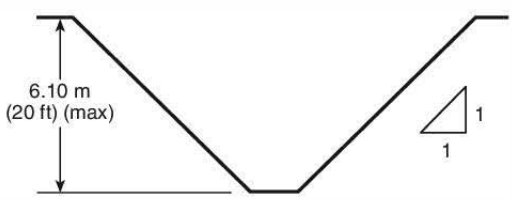


FIGURE B.1.2.1 Simple Slope. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.2.1]*

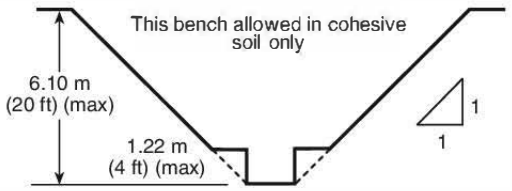


FIGURE B.1.2.2(a) Single Bench. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.2.2(a)]*

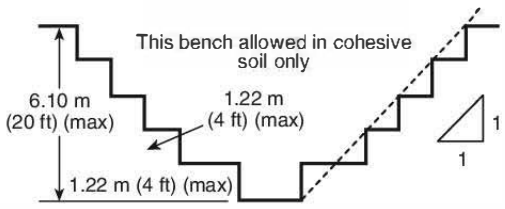


FIGURE B.1.2.2(b) Multiple Bench. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.2.2(b)]*

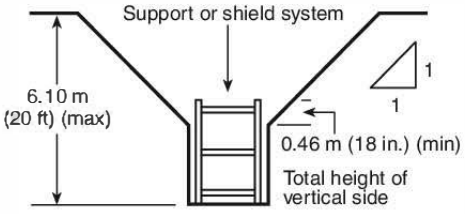


FIGURE B.1.2.3 Vertically Sided Lower Portion. *(Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.2.3)*

B.1.3.2 All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1. *(See Figure B.1.3.2.)*

B.1.3.3 All other sloped excavations shall be in accordance with the other options permitted in 1926.652(b).

B.1.4 Excavations Made in Layered Soils.

B.1.4.1 All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below. *[See Figure B.1.4.1(a) through Figure B.1.4.1(f).]*

B.1.4.2 All other sloped excavations shall be in accordance with the other options permitted in 1926.652(b).

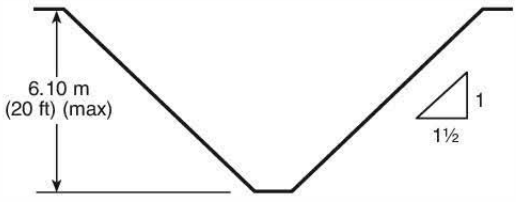


FIGURE B.1.3.1 Simple Slope. *(Source: 29 CFR 1926, Subpart P, Appendix B, Figure B.1.3.1)*

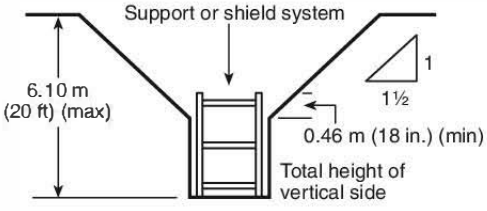


FIGURE B.1.3.2 Vertical Sided Lower Portion. *(Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.3.2)*

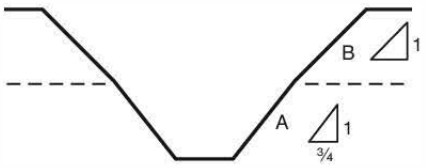


FIGURE B.1.4.1(a) B over A. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(a)]*

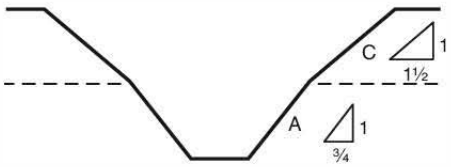


FIGURE B.1.4.1(b) C over A. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(b)]*

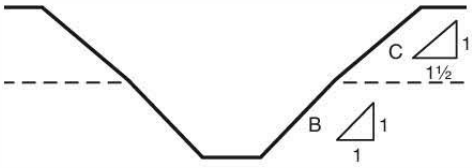


FIGURE B.1.4.1(c) C over B. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(c)]*

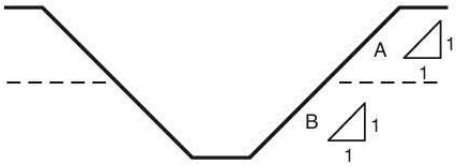


FIGURE B.1.4.1(d) A over B. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(d)]*

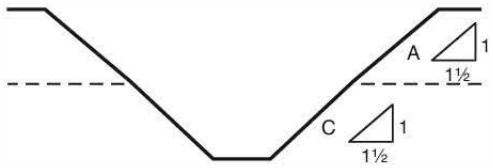


FIGURE B.1.4.1(e) A over C. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(e)]*

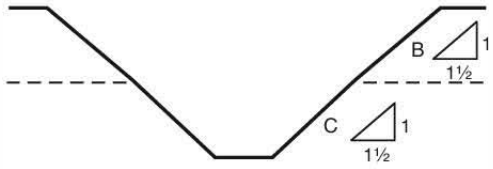


FIGURE B.1.4.1(f) B over C. *[Source: 29 CFR 1926, Subpart P, Appendix B, Figure B-1.4.1(f)]*

Annex C Structural Types

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 General. The material in Table C.1 and Figure C.1(a) through Figure C.1(n) can be used to clarify material found in the body of the document. Annex C is extracted from FEMA Earthquake Hazards Reduction Series 41, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook.*

Table C.1 Combinations of Materials in Structural Types (after ATC, 1987)

Structural Type Identifier	General Description
W	Wood buildings of all types
S1	Steel moment-resisting frames
S2	Braced steel frames
S3	Light metal buildings
S4	Steel frames with cast-in-place concrete shearwalls
C1	Concrete moment-resisting frames
C2	Concrete shearwall buildings
C3/C5	Concrete or steel frame buildings with unreinforced masonry in-fill walls
TU	Tilt-up buildings
PC2	Precast concrete frame buildings
RM	Reinforced masonry
URM	Unreinforced masonry

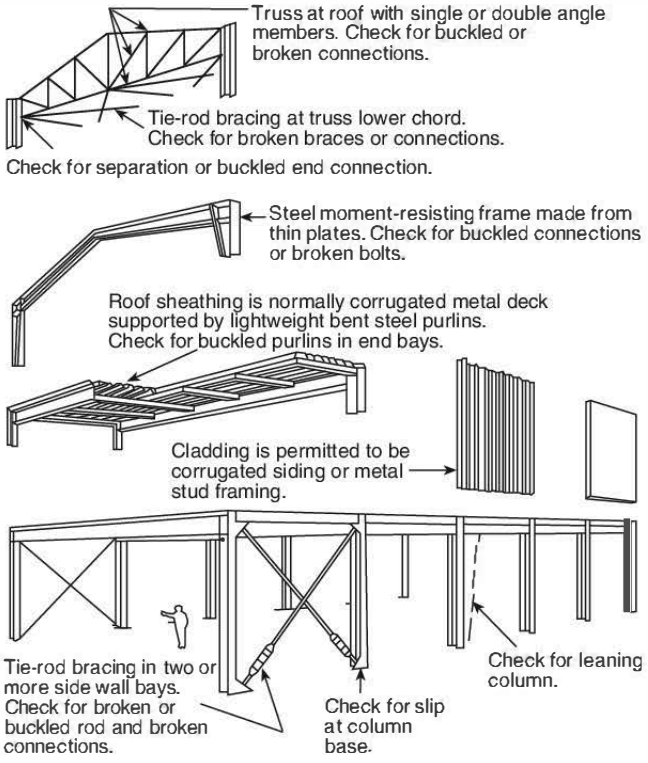

Truss at roof with single or double angle members. Check for buckled or broken connections.
Tie-rod bracing at truss lower chord. Check for broken braces or connections.
Check for separation or buckled end connection.
Steel moment-resisting frame made from thin plates. Check for buckled connections or broken bolts.
Roof sheathing is normally corrugated metal deck supported by lightweight bent steel purlins. Check for buckled purlins in end bays.
Cladding is permitted to be corrugated siding or metal stud framing.
Tie-rod bracing in two or more side wall bays. Check for broken or buckled rod and broken connections.
Check for slip at column base.
Check for leaning column.

FIGURE C.1(a) Light Metal Buildings (S3).

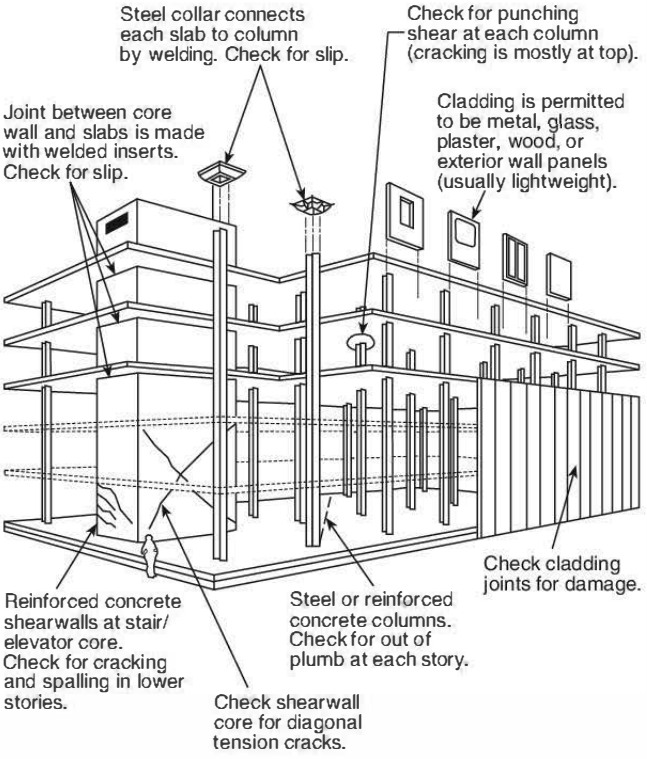

Steel collar connects each slab to column by welding. Check for slip.
Check for punching shear at each column (cracking is mostly at top).
Joint between core wall and slabs is made with welded inserts. Check for slip.
Cladding is permitted to be metal, glass, plaster, wood, or exterior wall panels (usually lightweight).
Check cladding joints for damage.
Reinforced concrete shearwalls at stair/ elevator core. Check for cracking and spalling in lower stories.
Steel or reinforced concrete columns. Check for out of plumb at each story.
Check shearwall core for diagonal tension cracks.

FIGURE C.1(b) Post-Tensioned Lift Slab Building.

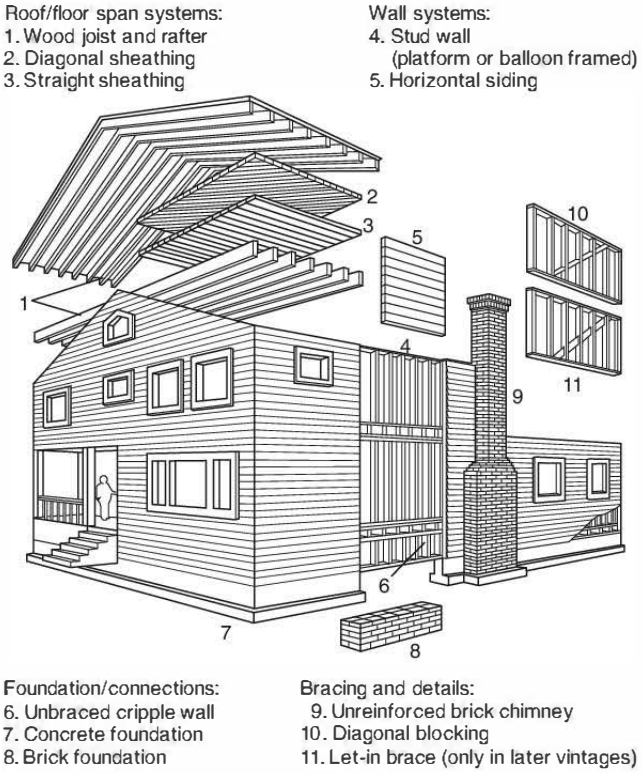


FIGURE C.1(c) Wood Stud Frame Construction.

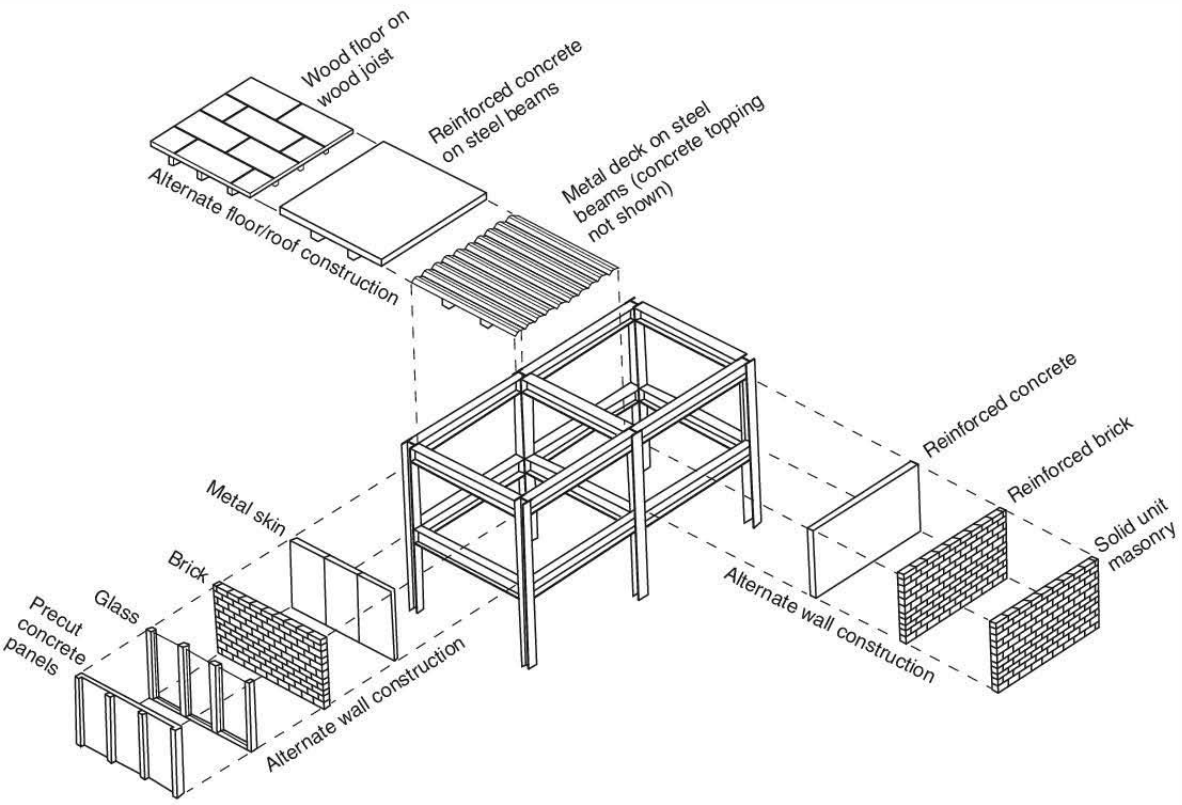


FIGURE C.1(d) Steel Moment-Resisting Frame.

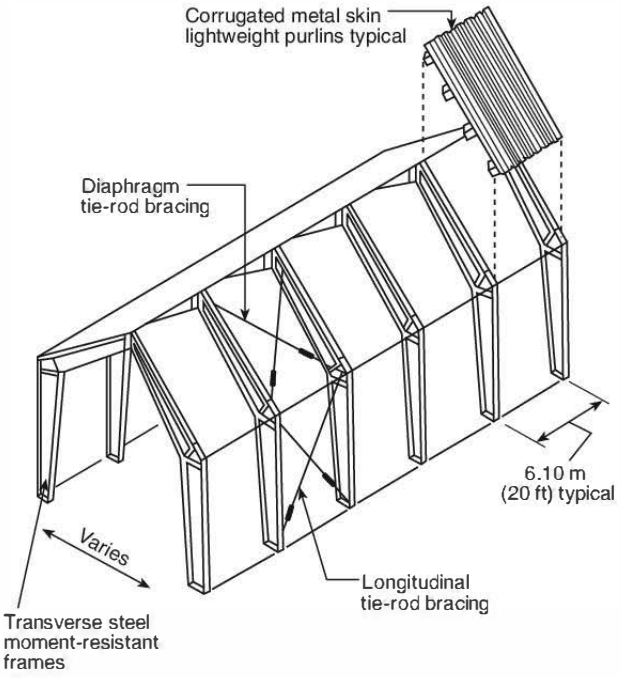


FIGURE C.1(e) Light Metal Construction.

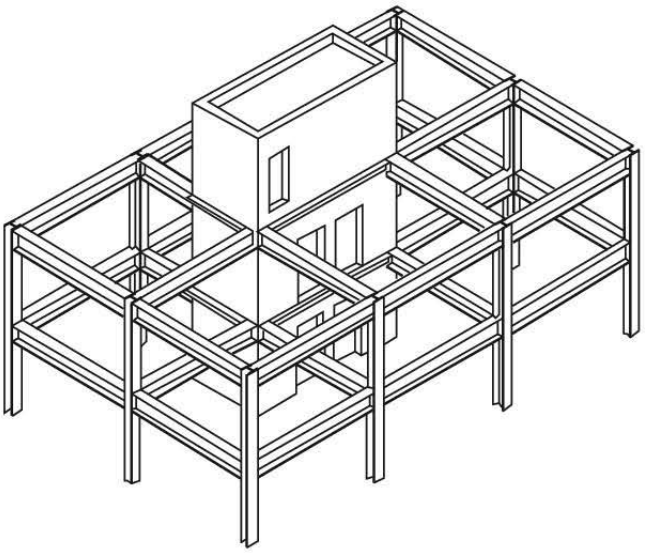
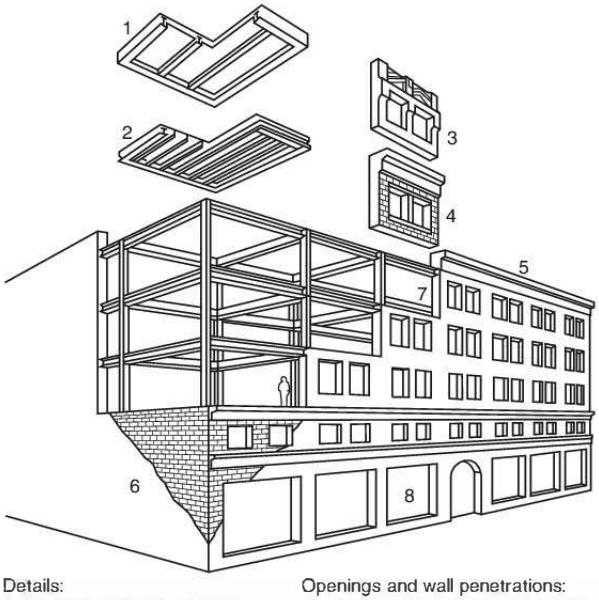


FIGURE C.1(f) Steel Frame with Shearwall.

Roof/floor span systems:
1. Steel framing with concrete cover
2. Wood floor joist and diaphragm (diagonal and straight)

Wall systems:
3. Non-load-bearing concrete wall
4. Non-load-bearing unreinforced masonry cover wall



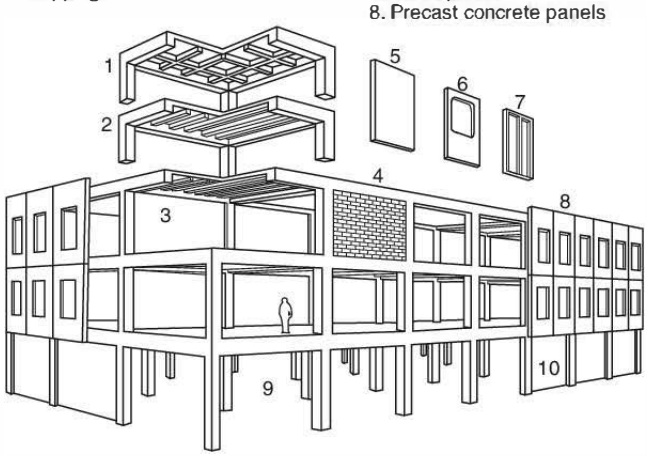
Details:
5. Unreinforced and unbraced parapet and cornice
6. Solid party walls

Openings and wall penetrations:
7. Window-penetrated front facade
8. Large openings of street-level shops

FIGURE C.1(g) Steel Frame with Unreinforced Masonry (URM) In-Fill.

Roof/floor diaphragms:
1. Concrete waffle slab
2. Concrete joist and slab
3. Steel decking with concrete topping

Curtain wall/nonstructural infill:
4. Masonry infill walls
5. Stone panels
6. Metal skin panels
7. Glass panels
8. Precast concrete panels



Structural system:
9. Distributed concrete frame

Details:
10. Typical tall first floor (soft story)

FIGURE C.1(h) Concrete Moment-Resisting Frame.

Roof/floor span systems:
1. Heavy timber rafter roof
2. Concrete joist and slab
3. Concrete flat slab

Wall system:
4. Interior and exterior concrete beating walls
5. Large window penetrations of school and hospital buildings

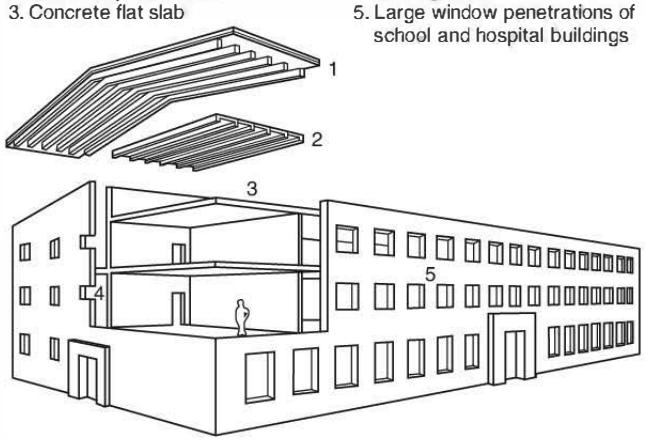
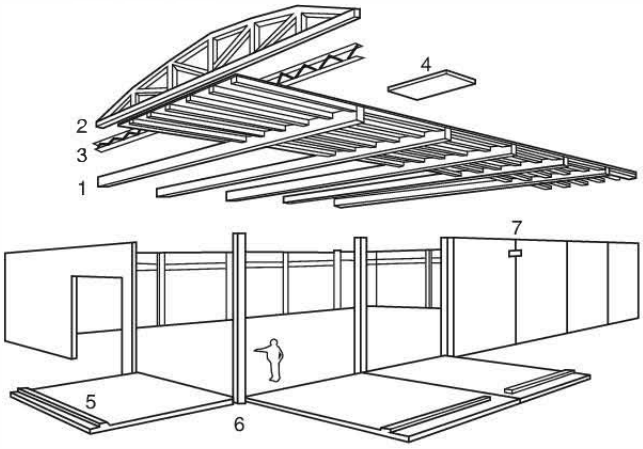


FIGURE C.1(i) Concrete Shearwall.

Roof/floor span systems:
1. Glue laminated beam and joist
2. Wood truss
3. Light steel-web joist

Roof/floor diaphragms:
4. Plywood sheathing



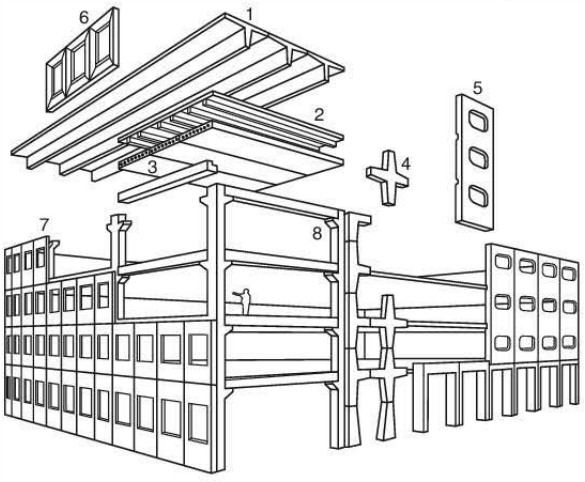
Details:
5. Anchor-bolted wooden ledger for roof/floor support

Wall systems:
6. Cast-in-place columns — square, T-shape, and H-shape
7. Welded steel plate-type panel connection

FIGURE C.1(j) Tilt-Up Construction Typical of the Western United States; Tilt-Up Construction in the Eastern United States Can Incorporate a Steel Frame.

Roof/floor span systems:
1. Structural concrete T sections
2. Structural double T sections
3. Hollow-core concrete slab

Wall systems:
4. Load-bearing frame components (cross)
5. Multistory load-bearing panels



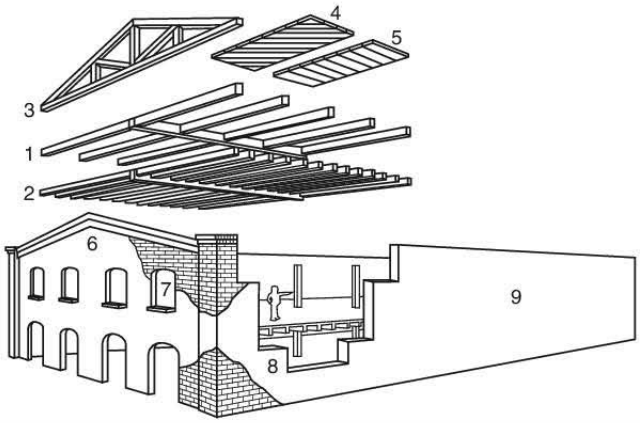
Curtain wall system:
6. Precast concrete panels
7. Metal, glass, or stone panels

Structural system:
8. Precast column and beams

FIGURE C.1(k) Precast Concrete Frame.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)
3. Wood truss-pitch and curve

Roof/floor diaphragms:
4. Diagonal sheathing
5. Straight sheathing



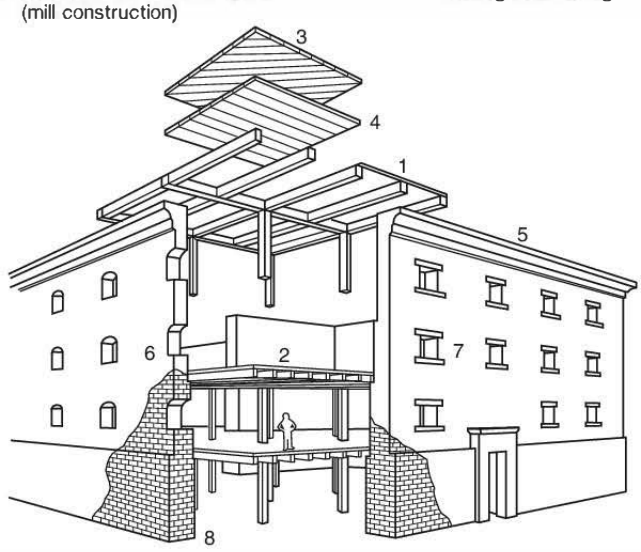
Details:
6. Typical unbraced parapet and cornice
7. Flat arch window openings

Wall systems:
8. Bearing wall — four or more wythes of brick
9. Typical long solid party wall

FIGURE C.1(l) Unreinforced Masonry Bearing Wall, Example 1 of 3.

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)

Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing



Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Small window penetrations (if building is originally a warehouse)

Wall systems:
8. Bearing wall — four to eight wythes of brick

FIGURE C.1(m) Unreinforced Masonry Bearing Wall, Example 2 of 3.

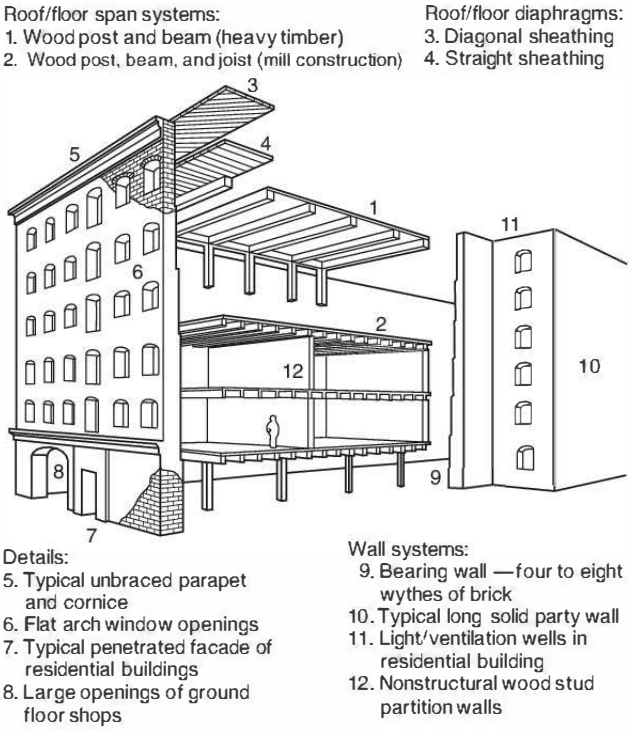

Roof/floor span systems:
1. Wood post and beam (heavy timber)
2. Wood post, beam, and joist (mill construction)
Roof/floor diaphragms:
3. Diagonal sheathing
4. Straight sheathing
Details:
5. Typical unbraced parapet and cornice
6. Flat arch window openings
7. Typical penetrated facade of residential buildings
8. Large openings of ground floor shops
Wall systems:
9. Bearing wall — four to eight wythes of brick
10. Typical long solid party wall
11. Light/ventilation wells in residential building
12. Nonstructural wood stud partition walls

FIGURE C.1(n) Unreinforced Masonry Bearing Wall, Example 3 of 3.

Annex D External Resources

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

D.1 General Considerations. The research and documentation of available external resources that can augment its internal capabilities form a crucial component in the overall ability of the AHJ to respond and operate at technical rescue incidents.

Due to the potential complexity of related technical search and rescue incidents and the variety of conditions and factors that can exist at site-specific or large-scale incidents, external resource allocation and deployment becomes necessary to support the search and rescue function. The AHJ can develop a comprehensive list of resources that can aid the responding agency by first using the hazard identification and risk assessment evaluation to identify those factors that currently can limit its overall response capability. Once limitations or resource deficiencies are identified, the AHJ can develop a resource database by reviewing those firms or businesses that are located within the jurisdiction. The telephone directory for the jurisdiction is an excellent reference that provides general categories and listing headings for companies, firms, and agencies that can become sources for resource allocation.

The identification of area needs can be associated with the following four general categories, though there may be others:

(1) Technical services
(2) Equipment
(3) Supplies
(4) Services

In addition, the AHJ should identify and contact local professional societies, associations, and trade groups, which can become excellent sources for technical support and resource development. Such professional groups include the following:

(1) American Institute of Architects (AIA)
(2) American Society of Consulting Engineers (ASCE)
(3) Association of Building Contractors (ABC)
(4) Local or regional builders exchange
(5) Construction Specification Institute (CSI)
(6) American Society of Safety Engineers (ASSE)
(7) American Public Works Association (APWA)
(8) Association of General Contractors (AGC)
(9) International Association of Bridge, Structural and Ornamental Iron Workers
(10) National Association of Demolition Contractors

The development of a community resource directory based on these contacts documents and makes readily available the variety of resources that might be needed in the event of a technical rescue incident. The community resource directory should include information on each firm, company, or agency appearing in the directory. A profile of the specialized resource(s) available, along with contact person(s) information, including telephone numbers for both home and work, also should be included.

Although the compiled data can be entered and stored on a computer database, a binder or book-formatted system should be used to adapt easily for field use. The use of laptop computer notebooks with disk-formatted data can also prove useful, and consideration should be given to the longevity and portability provided by battery packs.

A Memorandum of Agreement (MOA) should be developed that outlines specifications for equipment and resource allocation, availability of services and procedures for procurement, and subsequent financial reimbursement for services or equipment supplied.

In addition to the types of resources previously identified, the AHJ also should consider the development of a resource guide for the procurement of technical services from individuals associated with specific groups or agencies. This resource guide could include profiles of personnel, such as canine handlers with search dogs, technical rescue specialists, industrial hygienists, riggers, and so forth, who, on an on-call basis, could respond and augment on-scene resources.

The AHJ should not disregard resource acquisition requests to agencies and groups outside the immediate boundaries of the jurisdiction. Regional, statewide, and national resources could be identified based on the overall projected needs determined through the hazard identification and risk assessment.

Depending on the size and magnitude of the incident, resource availability might not be adequate to meet incident logistical needs, or the resources might be affected by whatever caused the incident, especially where a large area within the jurisdiction is part of the overall incident conditions. Such could be the case in an earthquake, hurricane, flooding, or other large-scale natural disaster.

Regional, multistate, or national deployment of specialized rescue teams or task forces should be considered in the development of the overall resource directory to provide additional capabilities as incident conditions and incident magnitude necessitate.

Annex E Hazards Found in Structural Collapse

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

E.1 General Hazards. General hazards associated with search and rescue operations at structural collapses can present the AHJ with uniquely challenging situations. The AHJ should consider the following potential hazards when providing training to its members:

(1) *Utilities.* Control of the utilities in and around a structural collapse is critical to ensure the safety of responding personnel and victims. The AHJ should provide its members with training in the control of these services to provide a safe environment in which to operate and to ensure the safety of victims. The following utilities should be considered when providing training:
   (a) Electrical services (primary and secondary)
   (b) Gas, propane, fuel oil, or other alternative energy sources (primary systems)
   (c) Water
   (d) Sanitary systems
   (e) Communications
   (f) Secondary service systems (i.e., compressed, medical, or industrial gases)

(2) *Hazardous Materials.* Collapsed structures might include various materials unique to an occupancy that, when released during a structural collapse, could pose a hazard to victims and responders. The AHJ should provide members with training in the recognition of potential hazardous materials releases, the determination of an existing hazard, and the methods used to contain, confine, or divert hazardous materials to conduct operations safely and effectively.

(3) *Personal Hazards.* At the site of any structural collapse, there are many dangers that pose personal injury hazards to the responders. The AHJ should train members to recognize the personal hazards they encounter and to use the methods needed to mitigate these hazards to help ensure their safety. Every member should be made aware of hazards such as trips, falls, blows, punctures, impalement, and so forth.

(4) *Confined Space.* Some structural collapses necessitate a confined space rescue. Responding personnel should be familiar with and trained in confined space rescue requirements and techniques. The AHJ should determine the applicable laws and standards related to confined space rescue and should provide members with training in confined space rescue.

(5) *Other Hazards.* There are numerous other hazards associated with structural collapses. The AHJ should make every effort to identify the hazards that might be encountered within the jurisdiction and should provide members with training and awareness of these other hazards to allow them to perform rescue operations safely and effectively.

Hazard recognition training should include the following as a minimum:

(1) Recognition of building materials and structural components associated with light-frame ordinary construction
(2) Recognition of unstable collapse and failure zones of light-frame ordinary construction
(3) Recognition of collapse patterns and probable victim locations associated with light-frame ordinary construction

E.2 Four Categories of Building Construction. The construction categories, types, and occupancy usage of various structures might necessitate the utilization of a variety of different techniques and material. The four construction categories that the rescuer most likely will encounter in collapse situations are light-frame, heavy wall, heavy floor, and precast concrete construction. The following four categories usually comprise the majority of structures affected by a collapse:

(1) *Light-Frame Construction.*
   (a) Materials used for light-frame construction are generally lightweight and provide a high degree of structural flexibility in response to forces such as earthquakes, hurricanes, tornados, and so forth.
   (b) These structures typically are constructed with skeletal structural frame systems of wood or light-gauge steel components that provide support to the floor and roof assemblies.
   (c) Examples of this construction type include wood frame structures used for residential, multiple low-rise, and light commercial occupancies up to four stories in height. Light-gauge steel frame buildings include commercial, business, and light manufacturing occupancies and facilities.

(2) *Heavy Wall Construction.*
   (a) Materials used for heavy wall construction are generally heavy and utilize an interdependent structural or monolithic system. These types of materials and their assemblies tend to produce a structural system that is inherently rigid.
   (b) This construction type usually is built without a skeletal structural frame. It utilizes a heavy wall support and assembly system that provides support for the floors and roof areas.
   (c) Occupancies utilizing tilt-up concrete construction are typically one to three stories in height and consist of multiple, monolithic concrete wall panel assemblies. They also use an interdependent girder, column, and beam system for providing lateral wall support of floor and roof assemblies. Such occupancies typically include commercial, mercantile, and industrial usage. Materials other than concrete now are being utilized in tilt-up construction.
   (d) Examples of this type of construction include reinforced and unreinforced masonry buildings typically of low-rise construction, one to six stories in height, and of any occupancy type.

(3) *Heavy Floor Construction.*

(a) Structures of heavy floor construction are built utilizing cast-in-place concrete construction consisting of flat slab panel, waffle, or two-way concrete slab assemblies. Pretensioned or post-tensioned reinforcing steel rebar or cable systems are common components used for structural integrity. The vertical structural supports include integrated concrete columns, concrete-enclosed steel frame, or steel frame, which carry the load of all floor and roof assemblies. This type of structure includes heavy timber construction that might use steel rods for reinforcement.

(b) The reinforcing steel, along with the varying thicknesses of concrete structural slab and girder supports utilized in this construction assembly, pose significant concerns with respect to breaching and void penetration.

(c) The loss of reinforcement capability and the integrity of structural loading capacity of the floor and wall assemblies create significant safety and operational considerations during collapse operations.

(d) Structural steel frame construction utilizes a skeletal framing system consisting of large-load-carrying girders, beams, and columns for structural support. These components represent a substantial weight factor for individual and assembly components. Floor systems consist of cast-in-place concrete slabs of varying thicknesses poured onto metal pan or structural metal floor decks and also might include precast and post-tensioned concrete plank systems. These concrete/metal pan floor assemblies are supported by the structural steel framing system.

(e) The exterior construction might consist of metal or masonry veneer, curtain wall, or composite material panel systems. Additionally, precast concrete or stoneclad panel systems might be present.

(f) Multiple assembly or component failures might be present in a collapse situation where isolated or multiple collapse conditions or collapse configurations exist.

(g) Examples of this type of construction include offices, schools, apartments, hospitals, parking structures, and multipurpose facilities. Heights vary from single-story to high-rise structures.

(4) *Precast Concrete Construction.*

(a) Structures of precast concrete construction are built utilizing modular precast concrete components that include floors, walls, columns, and other subcomponents that are field-connected at the site.

(b) Individual concrete components utilize imbedded steel reinforcing rods and welded wire mesh for structural integrity and might utilize either steel beam and column or concrete framing systems for the overall structural assembly and building enclosure.

(c) These structures rely on single- or multipoint connections for floor and wall enclosure assembly and are a safety and operational concern during collapse operations.

(d) Examples of this type of construction include commercial, mercantile, office, and multiuse or multifunction structures, including parking structures and large occupancy facilities.

Table E.2 lists the four model construction codes and standards commonly adopted within the United States and is provided to aid the AHJ in identifying the relationship of NFPA 1670 construction/collapse types to their applicable code. These model codes are referenced to classification Types I through V as specified in NFPA 220.

Figure E.2 is intended to identify construction/collapse types according to the classifications of NFPA 220 and is not part of any fire-resistive or fire rating/assembly requirement. In this table, the NFPA 1670 construction/collapse types are referenced to NFPA 220 to allow rapid correlation of construction code classification with the associated construction/collapse type. Depending on occupancy, usage, and actual size of the structure, some construction code classifications can exhibit characteristics of other than specifically correlated construction/collapse types.

Table E.2 Fire-Resistive Building Types

Reference	Fire-Resistive[a]		Noncombustible[a]			Ordinary[1a]		Heavy Timber[a]	Wood[a]	
NFPA 220[b,c]	Type I		Type II			Type III		Type IV	Type V	
	443	332	222	111	000	211	200	2HH	111	000
BOCA[d]	Type I		Type II			Type III		Type IV	Type V	
	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
UBC[e]	Type I		Type II			Type III		Type IV	Type V	
	P		P	P	NP	P	NP		P	NP
SBC[f]	Type I	Type II	Type IV			Type V		Type III	Type VI	
	433	332	P	NP	P	NP	2HH	P	NP	

[a]The table headings for fire-resistive, noncombustible, ordinary, heavy timber, and wood construction do not represent any special construction code classification but are meant to provide an easily recognizable general construction type reference.
[b]See NFPA 220 for common definitions of construction Types I through V.
[c]The three-digit arabic numbers that appear beneath each construction type heading designate the fire resistance rating requirements for certain structural elements specified in NFPA 220. They are provided in this table as a reference and to indicate their relationship to each type of construction.
[d]Construction types are referenced to the BOCA *National Building Code* for correlation with fire-resistive rating requirements for each construction type.
[e]Construction types are referenced to UBC, *Uniform Building Code*. The designations P and NP stand for "protected" and "not protected," respectively, as used within the UBC.
[f]Construction types are referenced to SBC, *Standard Building Code*. The designations P (protected) and NP (not protected) are used in order to provide correlation with *Uniform Building Code* information.

FIGURE E.2 Construction Code Classifications by Building Type.

Annex F Structural Marking Systems

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

Annex F is extracted from the Army Corps of Engineers.

F.1 General. One of the initial strategic concerns for personnel is the need to analyze the structure(s) involved in any collapse situation. This is especially true where there is more than one structure involved, as in cases of devastating earthquakes, hurricanes, or other natural or man-made disasters. The determination of the condition of the structure, hazards, and occupancy prior to the event will affect the overall search and rescue strategy.

A uniform building marking system has been developed by the FEMA National US&R Response System. There are 4 categories of FEMA US&R Markings:

(1) Structure Identification Marking
(2) Structure/Hazards Evaluation Marking
(3) Search Assessment Marking
(4) Victim Location Marking

The building marking system was established to ensure:

(1) Differentiation of structures within a geographic area.
(2) The structural condition and status of rescue operations within the structure are communicated.

Identification markings on structures may be made with International Orange spray paint (or construction crayon), placed on the building surface. In the case of hurricanes where many structures are involved, a system using a "Stick-on" Label should be used. Markings should be placed on normal address side of the structure.

F.2 Structure Identification Marking Within a Geographic Area. Structure identification within a geographic area is used to differentiate buildings by groups, such as by block(s) or jurisdictional area. It is imperative that personnel clearly identify each structure within a geographic area. This identification will assist both in the specific ongoing search and rescue effort and the long-term, post disaster identification of the site.

International orange spray paint or construction crayon is used to mark buildings with their street number so that personnel can differentiate one building from another. Existing numbers should be used to fill in any unknown numbers. If all numbers are unknown, arbitrary numbers can be used (odd and even used on opposite sides of the street). The primary method of identification should include the existing street name, hundred block, and building number. Such identification is not always possible due to post disaster conditions. *[See Figure F.2(a).]*

If at all possible, the existing street name and building number will be used. If some numbers have been obliterated, an attempt should be made to reestablish the numbering based on nearby structures. If no numbers are identifiable on a given block, rescue personnel will assign and identify the street name and numbers based on other structures in the proximity. The structures should then be numbered to differentiate them (using paint or crayon).

It is also important to identify locations within a single structure. The address side of the building is side A. Other sides of the structure are assigned alphabetically in a clockwise manner from side A around the building. *[See Figure F.2(b).]*

The interior of the structure can be divided into quadrants. The quadrants are identified alphabetically in a clockwise manner starting from where the side A and side B perimeter meet. The center core, where all four quadrants meet is identified as quadrant E (i.e., central core lobby, etc.). *[See Figure F.2(c).]*

Multistory buildings must have each floor clearly identified. If not clearly discernable, the floors should be numbers as referenced from the exterior. The grade (or street) level floor is designated floor 1, and moving upward the second floor would be floor 2, etc. Conversely, the first floor below grade (or street) level would be B-1, the second B-2, etc. For buildings where the street slopes, all at the incident must be informed as to which level will be called the first floor. *[See Figure F.2(d).]*

If a structure contains a grid of structural columns, they should be marked with 2 foot high, orange letters/numbers to further identify enclosed areas. If plans are available, use the existing numbering system. If plans are not available, letter the columns across the long side (side A in the example) starting from the left, and number the columns along the short side (side B in this example) starting from the front, side A. The story level should be added to each marked column, and be placed below the column locator mark. Example: "FL-2" = Floor 2. *[See Figure F.2(e).]*

F.3 Structure/Hazards Evaluation Marking. This system is designed to identify specific hazards associated with any collapsed structure. Personnel should be cognizant of the nationally accepted marking system and should be proficient in the use of the system.

After performing a building hazard identification, the responder makes a 2 ft × 2 ft (0.6 m × 0.6 m) square box on the building adjacent to the most accessible point of entry into any compromised structure. Paint sticks, lumber crayons or international orange aerosol spray paint can be used for this marking system. Peel and stick labels or stiff paper placards may be used to avoid paint damage. It is important that an effort is made to mark all normal entry points (side A if possible) to a building under evaluation to ensure that rescue personnel approaching the building can identify that it has been evaluated.

Materials and methods used for marking should be coordinated with the AHJ in order to avoid confusion with search and other marking.

The specific markings will be made inside the box to indicate the condition of the structure at the time of the assessment. Any identified hazards will be indicated, outside of the box, on the right side. Placards have space below the box for comments on hazards.

Normally the marking (or placards) would, also, be made immediately adjacent to the entry point identified as lowest risk. An arrow will be placed next to the box indicating the direction of the lowest risk entrance if the structure/hazard evaluation marking must be made somewhat remote from this entrance.

All rescue personnel must be aware of the possibility of, and look for other structure/hazards evaluation marking must be made somewhat remote from this entrance.

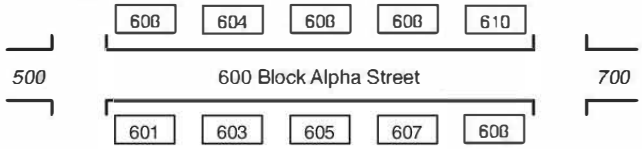
An important duty of a structure triage team is to clearly differentiate buildings by groupings such as a block(s) or jurisdictional areas/sectors. This geographic (area/sector) identification of buildings would be consolidated at the command post and used to deploy search and rescue personnel and/or track structure/hazard evaluation and search assessment information.

It is imperative that each structure within a geographic area is clearly defined. This identification will assist both in the specific ongoing search and rescue effort and in the long-term post-disaster identification of the site. This identification is important from a technical documentation perspective regarding the specific events that took place at a given site. Structure identification has a significant impact on overall scene safety and the safety of task force personnel.

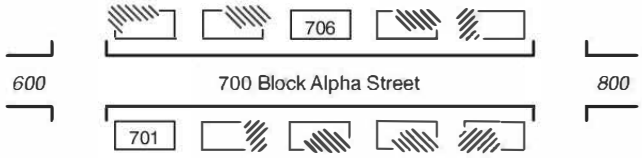
It is important to clearly identify each separate structure within a geographic area when information is being disseminated to other operational entities. The primary method of identification should be the existing street name, hundred block, and building number. Obviously, such identification is not always possible due to post-disaster site conditions. In these situations, it is important that the task force personnel implement the system that follows for structure identification.

This system builds upon the normal pre-disaster street name, hundred block, and building number. As task force personnel establish a need to identify a structure within a given block, they will do the following:

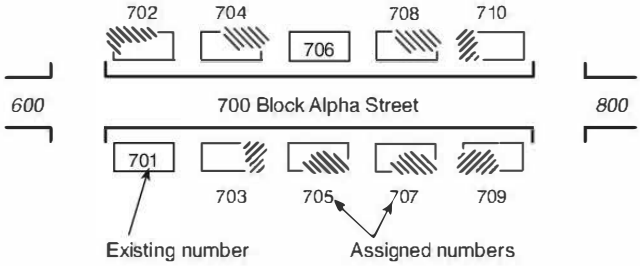
1. Each structure should be identified by existing street name and building number.



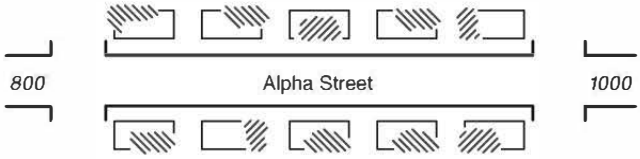
2. If some previously existing numbers have been obliterated, an attempt should be made to re-establish the numbering system based upon one or more structures that still display an existing number.



3. The damaged building(s) would be assigned numbers to separately identify them as indicated. The front of the structure(s) in question should be clearly marked with the new numbers being assigned using international orange spray paint.



4. If no number is identifiable in a given block, task force personnel will identify the street name and the hundred block for the area in question on other structures in proximity to the site in question.



5. In this case, structures will be assigned the appropriate numbers to designate and differentiate them. The front of the structure(s) in question should be clearly marked with the new number being assigned using international orange spray paint.

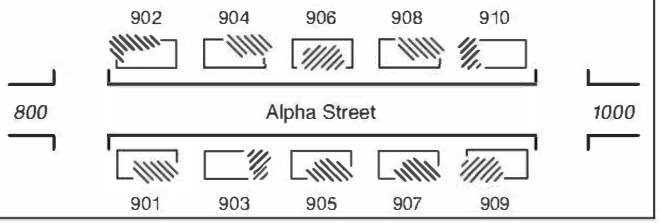


FIGURE F.2(a) Structure Identification Marking System Within a Geographic Area.

As each subsequent assessment is performed throughout the course of the mission, a new time, date, and unit (task force) ID entry will be made below the previous entry, or a completely new marking made if the original information is now incorrect.

The depiction of the various markings is as follows *[see Figure F.3(a)]*.

The time, date, and unit ID, are noted outside the box at the right-hand side. This info is made with paint stick or lumber crayon. The paper (or cardboard), stick-on placards may need to be attached using duct tape to assure their positioning. *[(See Figure F.3(b).]*

This example is for a medium risk building, and the arrow indicates the direction to the lowest risk entry (possibly a window, upper floor, etc.). Assessment was made on July 15, 1991, at 1:10 PM. There is an indication of natural gas in the structure. The evaluation was made by the #1 TF from the State of Oregon.

It should be understood that this building would not be entered until the hazmat (natural gas) has been mitigated.

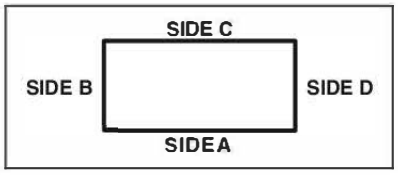


FIGURE F.2(b) Structure Identification Marking System Within a Geographic Area — Sides of a Single Structure.

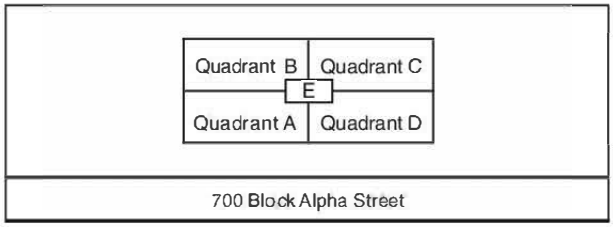


FIGURE F.2(c) Structure Identification Marking System Within a Geographic Area — Quadrants of a Single Structure.

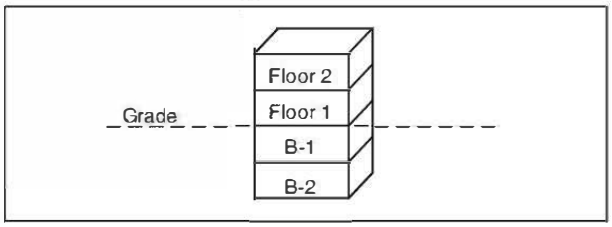


FIGURE F.2(d) Structure Identification Marking System Within a Geographic Area — Floors in a Single Structure.

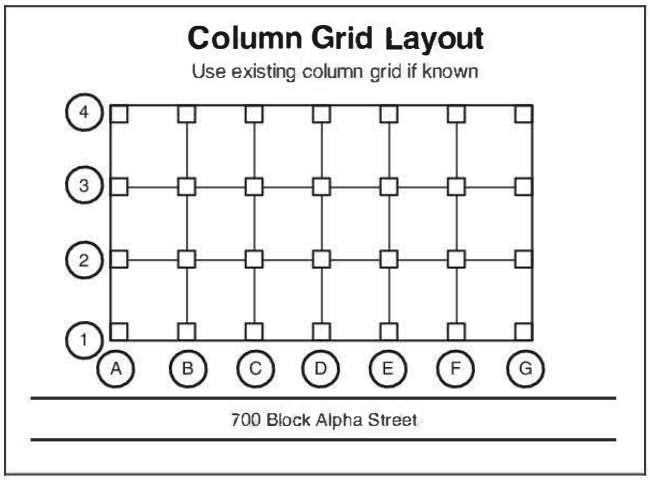


FIGURE F.2(e) Structure Identification Marking System Within a Geographic Area — Column Grid Layout.

When that mitigation is performed, this mark should be altered by placing a line through the HM and adding the time and unit who performed the mitigation. An entirely new mark could also be added when the mitigation is done, or after any change in conditions such as an aftershock. To indicate changed conditions when using labels or placards, one may cross out the hazard if mitigated or just replace the label/placard if appropriate.

Marking boxes may also be placed in each of the specific areas within the structure (i.e., rooms, hallways, stairwells, etc.) to denote hazardous conditions in separate parts of the building.

It should also be noted that the structure/hazards mark might not be made in many situations, such as structures in which rescuers are present at all times during the incident and after hurricanes for very simple structures.

F.3.1 Structure/Hazards Placard. This placard should be printed on adhesive backed, 8.5 inch x 11 inch heavy white paper, Rite in the Rain® (or equivalent) paper, or light cardboard. Cut in half to obtain two placards. *(See Figure F.3.1.)*

White color was selected to avoid being confused with the Green-Yellow-Red Placards that are placed during safety evaluation of structures by non-US&R engineers.

F.4 Search Assessment Marking. A separate and distinct marking system is necessary to denote information relating to the victim location determinations in the areas searched. This separate search assessment marking system is designed to be used

Low Risk for US&R Operations with a low probability of further collapse. Victims could be trapped by contents, building could be completely pancaked, or first story could be soft.

Medium Risk for US&R Ops, and structure is significantly damaged. Might need shoring, bracing, removal, and/or monitoring of hazards. The structure might be partly collapsed.

High Risk for US&R Ops, and the building might be subject to sudden collapse. Remote search operations can proceed at significant risk. If rescue operations are undertaken, significant and time-consuming mitigation should be done.

An arrow located next to a marking box indicates the direction to the lowest-risk entrance to the structure, if the marking box should need to be made remote from the indicated entrance.

HM

Indicates that a hazardous material condition exists in or adjacent to the structure. Personnel could be in jeopardy. Consideration for operations should be made in conjunction with the hazardous materials specialist. The type of hazard can also be noted.

FIGURE F.3(a)

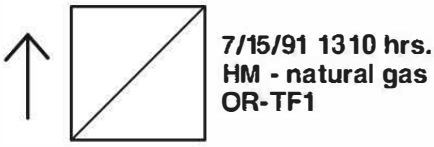


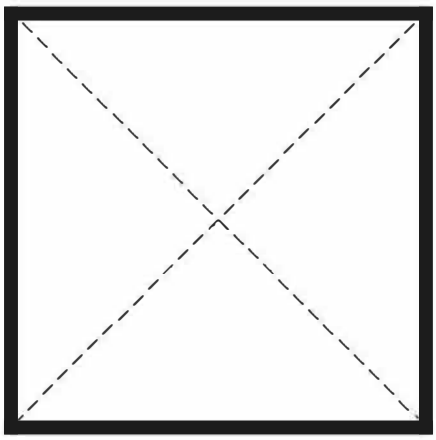
FIGURE F.3(b) Structure Hazards Evaluation Markings.

in conjunction with the structure and hazards evaluation marking system. The canine search specialist, technical search specialists, and/or search team manager (or any other search and rescue team member performing the search function) will draw and "X" that is 2 ft x 2 ft (0.6 m × 0.6 m) in size with international orange paint stick, lumber crayon or color spray paint (note that K9 may be adversely effected by the fumes from the spray paint). This X will be constructed in two operations—one slash drawn upon entry into the structure (or room, hallway, etc.) and a second crossing slash drawn upon exit *[see Figure F.4(a).]*

Distinct markings will be made inside the remaining quadrants of the X to clarify denote the search status and findings at the time of this assessment. The marks will be made with carpenter chalk or lumber crayon. The following illustrations define the search assessment marks *[see Figure F.4(b)]*.

In most cases, extemporaneous information will not be conveyed using the marking system. This type of communication will usually take place as a result of face-to-face meetings between search, rescue, and other components of the search and rescue team.

Search markings should be made at each area within a structure, such as rooms, voids, etc., but only information related to the results of the search will be marked upon exiting each space (no time or unit designation).



Structural / Hazard Evaluation

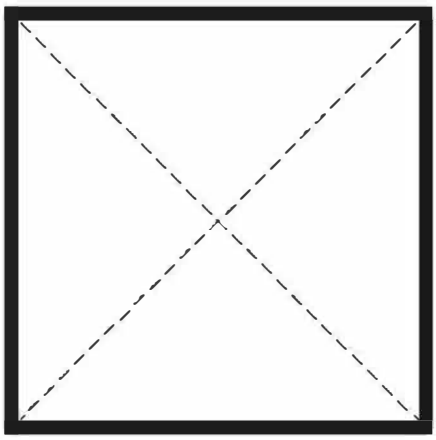
DATE	TIME	TF
HAZARDS:		

LR — **Low Risk** for US&R Ops. Low probability of further collapse. Victims could be trapped by contents, or building could be completely pancaked or soft 1st story

MR — **Medium Risk** for US&R Ops. Structure is significantly damaged. May need shoring, bracing, removal, and/or monitoring of hazards. The structure may be partly collapsed

XR — **High Risk** for US&R Ops. May be subject to sudden collapse. Remote search operations may proceed at significant risk. If Rescue Ops are undertaken, significant and time-consuming mitigation should be done

Should the marking box need to be made remote from the indicated entrance, place an arrow next to the box to indicate the direction to the lowest risk entrance to structure.



Structural / Hazard Evaluation

DATE	TIME	TF
HAZARDS:		

LR — **Low Risk** for US&R Ops. Low probability of further collapse. Victims could be trapped by contents, or building could be completely pancaked or soft 1st story

MR — **Medium Risk** for US&R Ops. Structure is significantly damaged. May need shoring, bracing, removal, and/or monitoring of hazards. The structure may be partly collapsed

XR — **High Risk** for US&R Ops. May be subject to sudden collapse. Remote search operations may proceed at significant risk. If Rescue Ops are undertaken, significant and time-consuming mitigation should be done

Should the marking box need to be made remote from the indicated entrance, place an arrow next to the box to indicate the direction to the lowest risk entrance to structure.

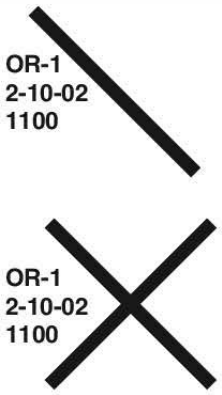
FIGURE F.3.1 Structure/Hazards Placard.

F.5 Victim Location Marking. During the search function, it is often necessary to identify the location of potential and known victims because debris in the area could completely cover, obstruct, or hide the location of any victims. When a known or potential victim is located and not removed immediately, victim location marking symbols are made by the search team or others aiding the search and rescue operation. These symbols should be made with orange spray paint or orange crayon *(see Figure F.5 that illustrates the marking system).*

F.6 The United Nations International Search and Rescue Advisory Group (INSARAG). The search marking system used by the United Nations includes the following:

(1) Structural marking should be applied on collapsed structures assessed by USAR teams.
   (a) The marking should be placed near the point of entry on the exterior of the collapsed structure that offers the best visibility.
   (b) All assessment results are to be reported to the OSOCC immediately.

(2) The marking consists of a 3.3 ft × 3.3 ft (1 m × 1 m) square box.

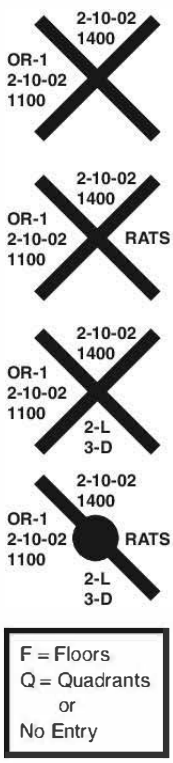


A single slash drawn upon entry into a structure or area indicates search operations are in progress. When entering a building or wing of a large building, add the search team identifier, date, and time of entry next to main entry.

Note: OR-1 is used instead of OR-TF1 to save time. "1100" is an abbreviation of "1100 hrs."

A crossing slash is drawn when personnel exit from the structure or area.

FIGURE F.4(a)



After exiting and drawing the second slash, add the following information:

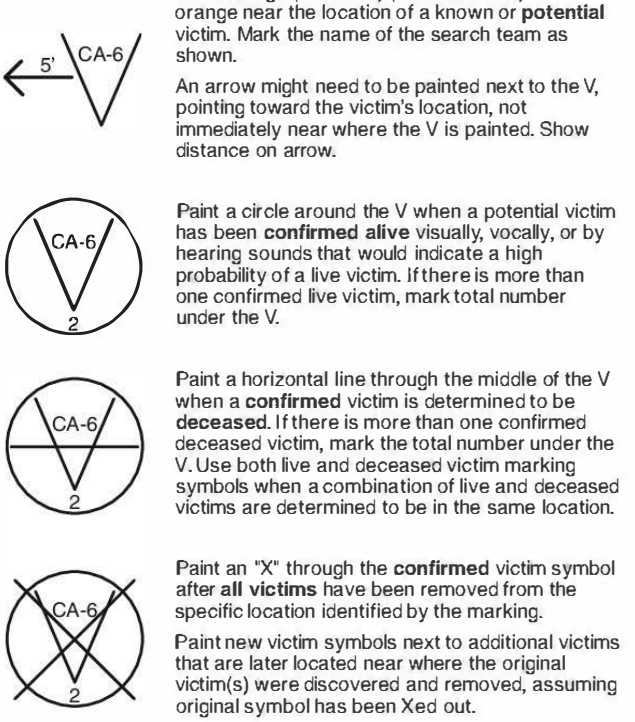
Top Quadrant: Time and date the Search Team left the structure.

Right Quadrant: Personal hazards.

Bottom Quadrant: Number of live and dead victims still inside the structure ("0" = no victims).

When the Recon Team leaves a structure without completing the search (due to aftershock, end of shift, etc.) then the second slash will not be made. A solid circle is drawn at the mid-length of the first slash. Date/time of exit, personal hazards, and victim information will be filled in. Also the number of quadrants or floors completed should be added in a box below the X. If the building has not been entered (e.g., during a hurricane), mark **No Entry** in the box.

FIGURE F.4(b) Example of Structural Evaluation Markings.



Paint a large (2 ft × 2 ft) (0.6 m × 0.6 m) "V" in orange near the location of a known or **potential** victim. Mark the name of the search team as shown.

An arrow might need to be painted next to the V, pointing toward the victim's location, not immediately near where the V is painted. Show distance on arrow.

Paint a circle around the V when a potential victim has been **confirmed alive** visually, vocally, or by hearing sounds that would indicate a high probability of a live victim. If there is more than one confirmed live victim, mark total number under the V.

Paint a horizontal line through the middle of the V when a **confirmed** victim is determined to be **deceased.** If there is more than one confirmed deceased victim, mark the total number under the V. Use both live and deceased victim marking symbols when a combination of live and deceased victims are determined to be in the same location.

Paint an "X" through the **confirmed** victim symbol after **all victims** have been removed from the specific location identified by the marking.

Paint new victim symbols next to additional victims that are later located near where the original victim(s) were discovered and removed, assuming original symbol has been Xed out.

FIGURE F.5 Victim Location Marking System.

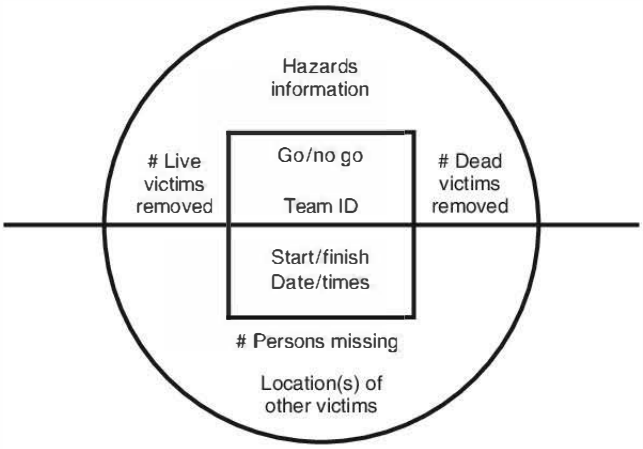


FIGURE F.6 INSARAG Marking System.

(3) Inside the box, mark the following:
   (a) Go" if deemed safe to enter
   (b) No Go" if deemed unsafe to enter
   (c) Team identification
   (d) Date and time start
   (e) Date and time finish
(4) Outside the box, mark the following:
   (a) Hazard information (top)
   (b) Missing persons (bottom)
   (c) Live victims extricated (left)
   (d) Dead victims removed (right)
(5) Additional information
   (a) When the USAR team has completed work on the structure to its capacity, a circle is drawn around the entire marking.
   (b) After all work on the structure has been completed and it is confirmed there are no more victims, a horizontal line is drawn through the entire marking. *(See Figure F.6.)*

Annex G Classification of Spaces by Types

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

G.1 Guidelines. Guidelines for initial response planning within the quantity and capability of available personnel and equipment should include, but are not limited to, the following:

(1) Response objectives for confined space emergencies
(2) Nonentry rescue options
(3) Entry-type rescue options
(4) Determination of whether rescuer and equipment capabilities are appropriate for available rescue options
(5) Needs analysis and procedures for providing emergency decontamination to victims suspected of being contaminated with a hazardous material *[See Figure G.1(a) through Figure G.1(c).]*

CONFINED SPACE Pre-Entry Evaluation

1	Location of confined space	Additional descriptor (Ex; location #, risk assessment #, etc.)	
	Description of confined space *(Tank #, Manhole, etc.)*		
2	Date issued	Time of entry/issued	Time permit expires *(Max duration = hr)*
	Description of work to be done		

3 Initial confined space safe work evaluation. If "Yes" is indicated for any of the questions, entry is not permitted until hazards are identified and mitigated by use of the permit and authorized Entry Supervisor.

If "No" is indicated for every question, work may proceed.

Evaluation signature _____

If any conditions change, work shall stop and the supervisor be contacted.

HAZARD IDENTIFICATION	Hazards present or potentially present (indicate "Yes" or "No" in every box)			
	Inherent hazards	Introduced hazards	Adjacent hazards	
Mechanical/electrical (springs, elevated parts, electric over 50 volts)				
Physical engulfment by material				
Pneumatic/hydraulic/fluids/gases (lifts, agitators, etc.)				
Chemical/biological/atmospheric				

Atmospheric monitoring should be conducted unless assessment of the space determines no potential hazardous atmosphere hazard

****Insert parameters and document here***

CONFINED SPACE ENTRY PERMIT

4

ENERGY SOURCES (*examples*)	Hazards present or potentially present (check all that apply)			7 HAZARD CONTROLLED BY If additional permits are used, indicate here in addition to other controls.
	Inherent hazards	Introduced hazards	Adjacent hazards	
Mechanical (springs, elevated parts, etc.)				
Electrical (motors, agitators, etc.)				
Pneumatic/hydraulic (lifts, agitators, etc.)				
Fluid/gases (CIP lines, nitrogen, steam, etc.)				
OTHER HAZARDS				
Unauthorized entry of personnel				
Noise >85 dB				
Excessive heat or cold				
Falling objects				

(NFPA 350, 1 of 2)

FIGURE G.1(a) Confined Space Rescue Pre-Incident Planning Form. ***(Courtesy of Wright Rescue Solutions, Inc., 2001.)***

	●ther permits: hot work, line break, L●T●, live electrical work									
	ATMOSPHERIC HAZARDS: *(record pre-entry and document continuously at least every two hours until exit)* Bump Test required and completed Yes ❑ Gas tester: type model _____ Serial # _____				Pre-entry required AM/PM:	Time AM/ PM:	Time AM/ PM:	Time AM/ PM:	Time AM/ PM:
	Continuous monitoring required Yes ❑ No ❑								
	Percent of oxygen 19.5% to 22%								
	Lower explosive limit <10% of LFL								
	Carbon monoxide <25 ppm								
	Hydrogen sulfide <5 ppm								
	●ther								
	TESTER INITIALS:								
	PERSONAL PROTECTIVE EQUIPMENT REQUIRED: *(for all, either check the box or circle "N/A")* N/A ❑ Respirator N/A ❑ Safety glasses w/side shields N/A ❑ Hard hat Type: _____ N/A ❑ Goggles N/A ❑ Face shield Model: _____ N/A ❑ Ear plugs/muffs N/A ❑ Boots Cartridge/filter: _____ N/A ❑ Gloves (Type: _____) N/A ❑ Disposal coveralls ❑ ●ther (specify: _____)									
5	**COMMUNICATIONS:** Entrant ❑ Verbal (only allowed for line of sight) ❑ Radio Emergency rescue will be requested by:									
6	**RESCUE:** *(for all, either check the box or circle "N/A")* N/A ❑ Full-body harness w/ "D" ring N/A ❑ Tripod/retrieval system N/A ❑ Fall-arresting equipment N/A ❑ Lifelines and safety or wrist harness N/A ❑ Emergency escape retrieval equipment ❑ Emergency response team has been notified of entry, hazards, and duration (still use for alternate procedure, or reclassification) ❑ Incident action plan has been completed and is available									
7	**ENTRANT(S):** I am aware of the hazards and their effects and will take the precautions required. _____ *Print name initial print name initial print name initial*									
8	**ATTENDANT(S):** I am aware of the hazards and their effects. I will arrange for rescue from outside the space, if required. _____ *Print name initial print name initial print name initial*									
9	**ENTRY SUPERVISOR:** I authorize entry into this confined space and verify that the hazards have been evaluated, control measures have been instituted, and the conditions are as indicated on this permit. _____ *Print name(s) department phone signature(s)*									
10	**CANCEL PERMIT:** This permit shall be canceled at the completion of the entry, or if hazards change, by placing a large "X" across both sides of the permit.									
11	**RESCUE & EMERGENCY CONTACT** _____ : (555) 555-5555									

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FIGURE G.1(a) ***Continued***

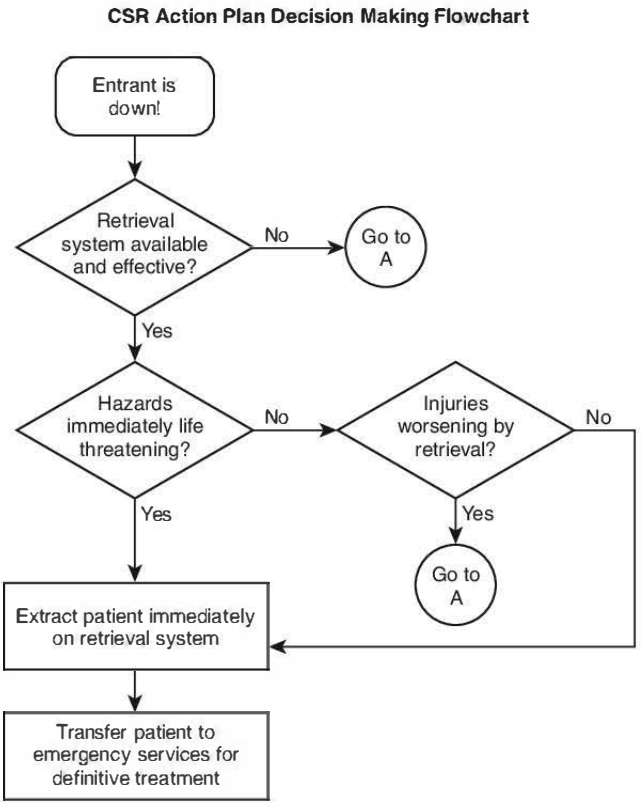

FIGURE G.1(b) Confined Space Rescue Plan Decision Making Flowchart. *(Courtesy of Wright Rescue Solutions, Inc., 2001.)*

G.2 Operational Procedures. Operational procedures for response implementation should include, but are not limited to, the following:

(1) Scene control procedures, including control zones and communication
(2) Incident management system consistent with the organization's standard operating procedure
(3) Nonentry retrieval
(4) Qualifying entry-type rescues
(5) Emergency decontamination as needed
(6) Technical-level rescue service assistance

G.3 Procedures for Mitigating Hazards. Specific procedures for mitigating hazards at confined space rescue can include, but are not limited to, consideration of the following:

(1) Personal protective equipment (PPE)
(2) Fall protection
(3) Harnesses
(4) Lockout/tagout procedures
(5) Hazard identification
(6) Scene assessment

G.4* Confined Space Hazard Identification. Procedures to perform a confined space hazard identification include, but are not limited to, the following:

(1) Identification of the important industrial documentation, where available, useful in hazard identification, including entry permits, lockout/tagout procedures and checklists, and hot work permits
(2) Selection of all applicable information necessary for emergency responders from chemical information documents (i.e., SDS)
(3) PPE for the hazard as per NFPA 472 and OSHA regulations in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)

G.5 Procedures for Scene Assessment. Procedures to perform a scene assessment to determine the magnitude of the problem in terms of life safety can include, but are not limited to, the following:

(1) The type, size, access, and internal configuration of the confined space. Classifying spaces by "types" can be useful in preparing a rescue training plan to include representative permit spaces for practicing rescue operations as specified by OSHA. These types focus mainly on the OSHA-specified criteria of opening size, configuration, and accessibility. Another important factor to consider is the internal configuration (congested or non-congested) of the permit-required confined space.
(2) Information regarding current and potential hazards that threaten victims and rescuers
(3) A risk/benefit analysis concerning the threat to rescuers in relation to the viability of victims

G.6 Procedures for Planning Entry-Type Rescues. Procedures for planning entry-type rescues with hazards should consider the following issues:

(1) Options for entry-type confined space rescues beyond the capability of operations-level personnel
(2) Selection, use, and maintenance of, as well as training relative to, personal protective clothing and equipment provided by the AHJ for operating in and around confined space emergencies
(3) Determination of response objectives based on circumstances of the confined space emergency. The response objective can involve any one of the following:
    (a) Victim rescue
    (b) Victim recovery
    (c) Remote extrication
    (d) Nonintervention
(4) Verification of the need for emergency decontamination
(5) Development of a plan of action, including safety considerations, consistent with the organization's standard operating guidelines, for entry-type confined space rescue. Components of a typical action plan might include the following:
    (a) Site assessment
    (b) Confined space assessment
    (c) Resource organization and accountability [incident management system (IMS)]
    (d) Perimeters and control zones
    (e) Hazard evaluation
    (f) A comprehensive risk/benefit analysis that evaluates the viability of the victim
    (g) Personal protective equipment
    (h) Chemical protective clothing
    (i) Specialized rescue equipment
    (j) Rescue/recovery objectives
    (k) On-scene work assignments
    (l) Communications procedures
    (m) Emergency decontamination procedures (victim)
    (n) Decontamination procedures (rescuers)

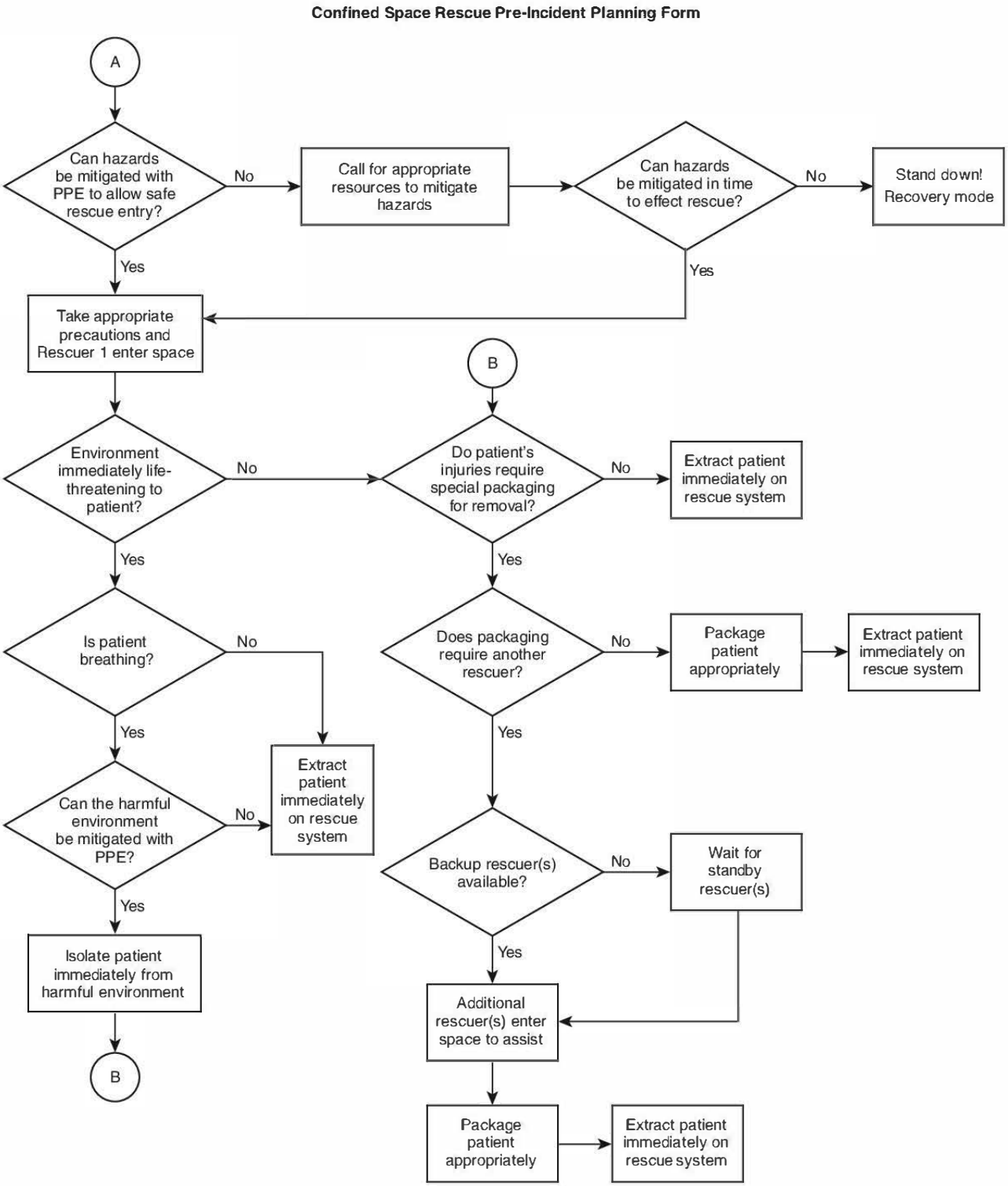

FIGURE G.1(c) Confined Space Rescue Pre-Incident Planning Form Flowchart. *(Courtesy of Wright Rescue Solutions, Inc., 2001.)*

(o) On-scene safety and health procedures, including personnel health monitoring, on-scene rehabilitation, emergency medical care procedures, and the designation of a safety officer
(p) Scene termination procedures

(6) Implementation of the planned response to successfully rescue or recover victims from confined spaces by completing the following tasks:
(a) Perform the duties of an assigned position within the local IMS
(b) Perform entry-type rescues from confined spaces
(c) Perform support functions for entry-type rescues from confined spaces
(d) Don, safely operate, and doff appropriate personal protective clothing including, but not limited to, liquid splash protection and vapor-protective clothing, which might be required when operating around the scene of confined space emergencies involving hazardous materials

(7) Development of procedures that include required equipment and safety precautions for the following entry-type confined space rescues:
(a) Vertical rescue
(b) Horizontal rescue
(c) Suspended victim rescue
(d) Entrapped or engulfed victim (collapse, particulate matter, etc.)

Annex H Excavation Requirements and Soil Types

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

H.1 Introduction. The following is excerpted from 29 CFR 1926.651, "Specific Excavation Requirements," and specifies soil types.

"Cemented soil" means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

"Cohesive soil" means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical side slopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay.

"Dry soil" means soil that does not exhibit visible signs of moisture content.

"Fissured" means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

"Granular soil" means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

"Layered system" means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

"Moist soil" means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

"Plastic" means a property of a soil that allows the soil to be deformed or molded without cracking or appreciable volume change.

"Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

"Soil classification system" means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of stable rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

"Stable rock" means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

"Submerged soil" means soil that is underwater or is free-seeping.

"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if one of the following conditions exists:

(1) The soil is fissured.
(2) The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
(3) The soil has been previously disturbed.
(4) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater.
(5) The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" means one or more of the following:

(1) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)
(2) Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam
(3) Previously disturbed soils except those that would otherwise be classed as Type C soil
(4) Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration
(5) Dry rock that is not stable
(6) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B

"Type C" means one or more of the following:

(1) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less

(2) Granular soils including gravel, sand, and loamy sand
(3) Submerged soil or soil from which water is freely seeping
(4) Submerged rock that is not stable
(5) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper

"Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

"Wet soil" means soil that contains significantly more moisture than moist soil but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

The classification of soil should be made based on the results of at least one visual and at least one manual analysis. Such analyses should be conducted by a competent person using tests described in Appendix A (Soil Classification) of 29 CFR 1926, Subpart P, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials or the U.S. Department of Agriculture textural classification system. The visual and manual analyses, such as those specified in Appendix A (Soil Classification) of 29 CFR 1926, Subpart P, should be designed and conducted to provide sufficient quantitative and qualitative information as might be necessary to identify properly the properties, factors, and conditions affecting the classification of the soil.

Annex I Building Collapse Patterns

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

I.1 Collapse Patterns and Potential Victim Locations. Collapse patterns and potential victim locations include the following:

(1) *Lean-to.* A lean-to is formed when one or more of the supporting walls or floor joists breaks or separates at one end, causing one end of the floor(s) to rest on the lower floor(s) or collapse debris. Potential areas where victims might be located are under the suspended floor and on top of the floor at the lowest level. *[See Figure I.1(a).]*
(2) *V.* When heavy loads cause the floor(s) to collapse near the center, a "V" is formed . Potential areas where victims might be located are under the two suspended floor pieces and on top of the floor in the middle of the V. *[See Figure I.1(b).]*
(3) *Pancake.* A pancake is formed when the bearing wall(s) or column(s) fails completely and an upper floor(s) drops onto a lower floor(s), causing it to collapse in a similar manner. Potential areas where victims might be located are under the floors and in voids formed by building contents and debris wedged between the floors. *[See Figure I.1(c).]*
(4) *Cantilever.* A cantilever is formed when one end of the floor(s) hangs free because one or more walls have failed and the other end of the floor(s) is still attached to the wall(s). Potential areas where victims might be located are on top of or under the floors. *[See Figure I.1(d).]*
(5) *A-frame.* An A-frame occurs when flooring separates from the exterior bearing walls but still is supported by one or more interior bearing walls or nonbearing partitions. The highest survival rate for trapped victims will be near the interior partitioning. Other victims will be located in the debris near both exterior walls. *[See Figure I.1(e).]*

The five collapse patterns previously shown were obtained from U.S. Department of Civil Defense documents and are based on World War II bomb damage to unreinforced masonry (URM) structures with wood floors and roof. There are other collapse patterns that should also be used to describe the result of extreme forces, other than bombs, on structures of common, modern construction types. Ten of these collapse patterns are shown and described in the section that follows.

I.2 Earthquake Collapse Patterns. Earthquake motion causes forces to be generated in all types of structures. In general, the forces are proportional to the weight of the structure. However, with careful attention to the design, using ductility and redundancy, many structures are earthquake resistant. The destructive forces affect the lateral resistance of the structure, such as shear-walls, moment frames, and X-bracing. Once the resistance of these elements has been overcome, gravity will cause the structure to move toward the ground. The following are collapse patterns that have been observed:

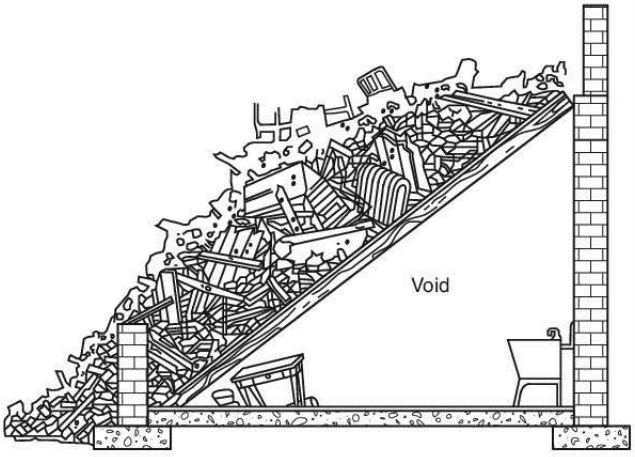

FIGURE I.1(a) Lean-to Floor Collapse. *(Courtesy of U.S. Department of Civil Defense)*

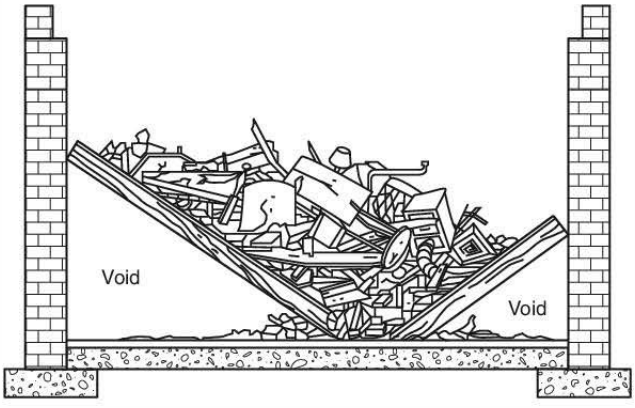

FIGURE I.1(b) V-Shape Floor Collapse. *(Courtesy of U.S. Department of Civil Defense)*

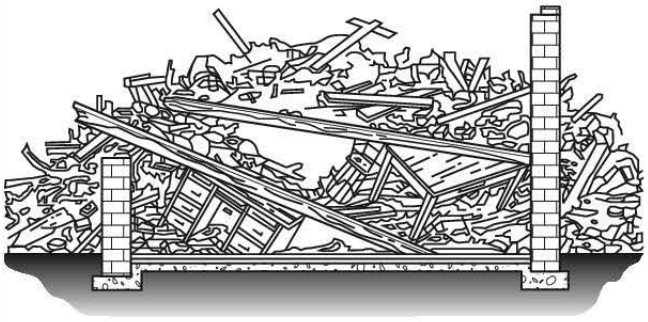

FIGURE L1(c) Pancake Floor Collapse. *(Courtesy of U.S. Department of Civil Defense)*

FIGURE I.1(d) Cantilever Floor Collapse. *(Courtesy of U.S. Department of Civil Defense)*

(1) **Offset Collapse Pattern — Light Frame Construction.** This pattern develops due to the unique nature of light frame construction. The lateral load–resisting walls for these structures can be characterized as "skin and bones" construction, where lateral resistance to racking is provided by the sheathing (skin), but the vertical load is supported by studs and posts (bones). Therefore, when earthquake motion causes the sheathing to fail (usually in the first story), the story (or stories) will start to lean over (rack). The vertical load capacity of the studs and posts is still intact, so the structure will progressively lean over until it has offset about as much as the height of the story (or stories) that have failed sheathing. *[See Figure I.2(a).]*

(2) **Wall-Fall Collapse Pattern — Heavy Wall Construction, Unreinforced Masonry (URM), and Tilt-Up.** This pattern develops when earthquake motion causes high forces to be developed in the heavy walls that overcome the connections between the walls and the floors/roof. The walls can then fall outward, leaving the floors/roof partially unsupported. The pattern is somewhat different for URM and tilt-up construction.

(a) **Wall-Fall URM.** Since the walls are relatively weak, and earthquake motion causes forces to be greatest at the top of the wall and decrease with height, the parapets and upper story walls are most likely to fall. The fall zone is normally much less than the wall height. Because many URM buildings have residential occupancies with interior partitions, the light, interior wood frame construction will remain uncollapsed and supported on interior bearing and nonbearing walls. In extreme cases the full height of the URM wall will fall, and then collapse of interior spaces is more likely. It should be noted that URM construction in California has been the subject of statewide ordinances that require upgrade modifications that greatly reduce the chance of this type of collapse. There are many vulnerable URM buildings in the earthquake regions in the central and eastern United States. *[See Figure I.2(b).]*

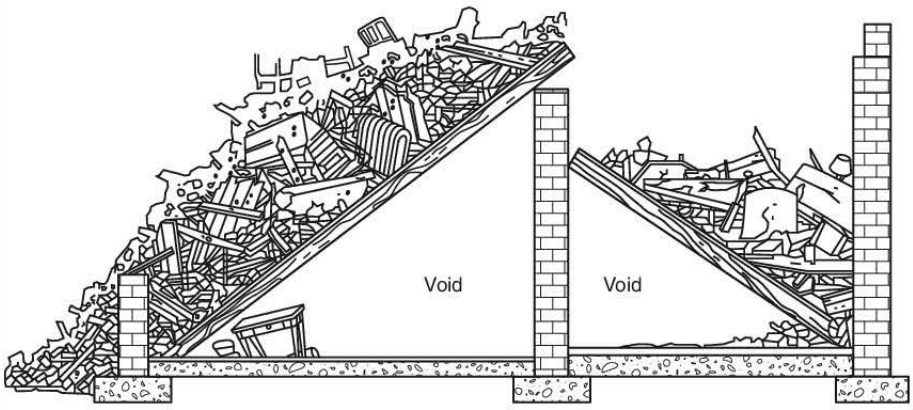

FIGURE I.1(e) A-Frame Floor Collapse. *(Courtesy of U.S. Department of Civil Defense)*

(b) **Wall-Fall Tilt-Up.** The 6 in. to 8 in. (0.15 m to 0.20 m) reinforced concrete walls for these structures will, in almost all cases, collapse as a unit. The fall zone in this case will be at least the height of the wall. Since this type of construction most commonly has warehouse occupancy with few partitions and fairly long roof spans, it is most likely that the end of the roof formerly supported by the wall will collapse to the ground. At that point, one would observe a lean-to roof collapse, unless a more extensive roof collapse was generated. *[See Figure I.2(c).]*

(3) **Pancake Collapse Pattern — Heavy Floor Construction.** This pattern develops when earthquake motion causes the columns to fail, commonly at their connection with the floors. The heavy floors are then driven down on top of each other by gravity. This type of collapse has been minimized in more modern structures (post 1975 in the western U.S.) that have been designed and built with greater ductility. *[See Figure I.2(d).]*

(4) **Overturn Collapse Pattern — Heavy Floor or Heavy Steel Construction.** This pattern develops when earthquake motion causes high tension and/or compression forces in the exterior columns of taller, slender buildings that have inadequate ductility in their designs. In the case of heavy floor buildings, the columns normally fail in tension at a spliced connection. In heavy steel buildings, the columns fail in compression by buckling. *[See Figure I.2(e).]*

(5) **Soft First Story Collapse Pattern — Heavy Floor.** This pattern develops in a building that has occupancy in the first story, which does not permit many shear-resisting walls, and with upper stories, which have many shear walls. Earthquake motion becomes concentrated in the soft story as the minimal amount of shear resistance is overcome and the story collapses. *[See Figure I.2(f).]*

(6) **Random Parts Collapse Pattern — Precast Concrete Construction.** This pattern develops when earthquake motion causes forces in the connections between the precast elements. When the connections fail, the affected parts fall and a progressive collapse can be triggered that can involve most of the structure. This type of collapse most often occurs in "economically engineered" precast structures, such as parking garages throughout the United States, as well as other occupancies in the central and eastern United States. Once the collapse starts, it is hard to predict how many parts will be involved, but gravity will bring those parts directly to the ground below. *[See Figure I.2(g).]*

(7) **Wind Collapse.** Depending on its speed, wind can cause many detrimental effects to structures and parts of structures. Light, projecting parts can be lifted away and deposited at great distances. In very severe tornado winds, light structures are shredded and torn apart. A common collapse pattern that has been observed for partially remaining structures is the roof lift-off collapse pattern, which occurs in light frame and heavy wall construction. This pattern develops when the roof is lifted off, either due to aerodynamic lift or the wind penetrating the structure. Once the lateral transfer bracing provided by the roof has been removed from the walls, the walls are vulnerable to falling out (or in). The wall-fall can be limited at corners or if there are other elements that can provide lateral support. *[See Figure I.2(h).]*

(8) **Blast Collapse.** Blasts produce very high, but short-duration, pressures on surfaces in all directions from the ignition point. Light structures will be completely blown away, in no particular pattern. The effect of blast is very different from that of earthquake. In the case of blast, the pressure is exerted equally in all directions from the origin. A common collapse pattern is the lift and drop collapse pattern. This pattern develops when a blast originates within or immediately adjacent to a structure. The pressure wave radiates out in all directions, but the most detrimental effect is upward pressures on concrete slabs that have been designed for only gravity forces. If the reinforcing steel has been provided to resist only downward, gravity forces, the concrete has only its weight to resist the upward blast pressure. Since concrete is weak in tension, the slabs are lifted, destabilizing adjacent columns, and a significant part of the structure falls to the ground (or basement). Part of the damaged slabs can end up precariously hanging from the remaining structure. Figure I.2(i) shows a three-step, probable collapse sequence based on the Murrah Federal Office Building, Oklahoma City, 1995.

(9) **Fire Collapse.** Depending on the type of construction, there are many collapse patterns due to fire. In the case of light frame construction, the entire structure might be consumed. There are a few cases where a heavy floor or heavy, fireproofed steel has collapsed. Figure I.2(j) shows a common type of collapse pattern caused by fire. This pattern develops when the wood floor and the roof, which provide the lateral, transfer bracing for the walls, have burned out. This leaves the unbraced walls standing without adequate lateral support, and they could collapse in high winds.

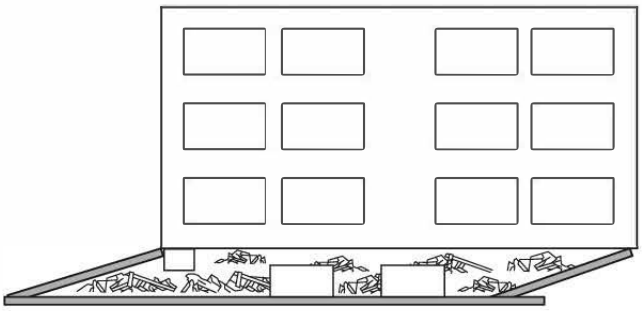

FIGURE I.2(a) Offset Collapse Pattern — Light Frame Construction.

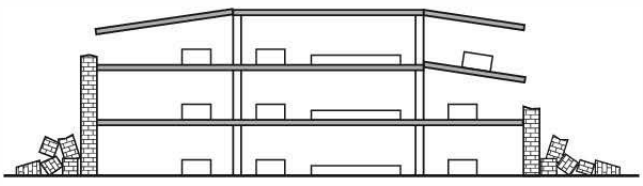

FIGURE I.2(b) Wall-Fall Collapse Pattern — Heavy Wall — URM Construction.

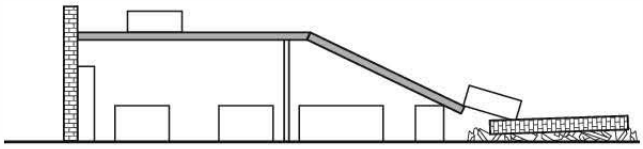

FIGURE I.2(c) Wall-Fall Collapse Pattern — Heavy Wall — Tilt-Up Construction.

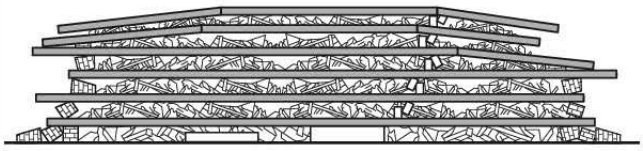

FIGURE I.2(d) Pancake Collapse Pattern — Heavy Floor Construction.

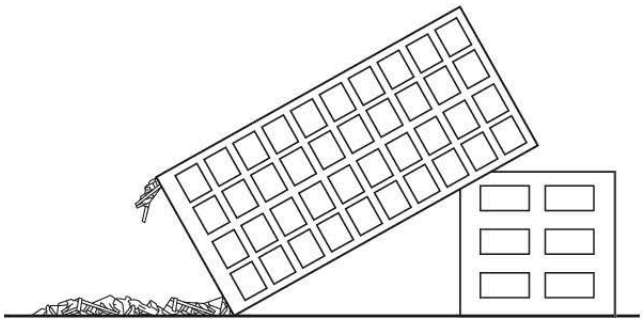

FIGURE I.2(e) Overturn Collapse Pattern — Heavy Floor or Heavy Steel Construction.

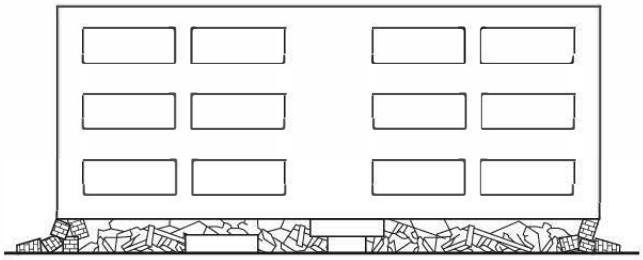

FIGURE I.2(f) Soft First Story Collapse Pattern — Heavy Floor Construction.

Annex J Animal Rescue

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

J.1 General. Chapter 9 is intended to address all animals as defined in this document. As an overlying concept, the most significant changes to requirements as defined in Chapters 1 through 15 are that the animal can be larger, can require special equipment or improvised systems, has a greater ability to cause harm to the rescuer (due to unpredictable behavior, force potential, size, biting, and kicking, among other hazards), and that system safety factors can be lower than what is considered appropriate for human rescue loads — potentially as low as a 2 to 1 system safety factor.

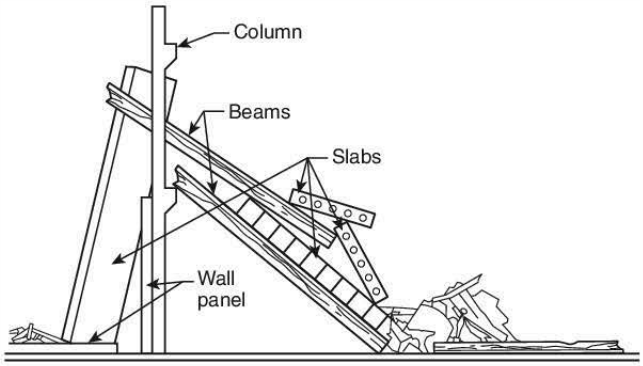

FIGURE I.2(g) Random Fall Collapse Pattern — Precast Concrete Construction.

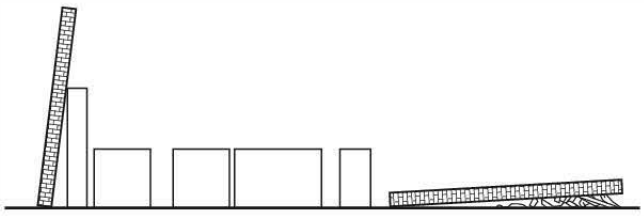

FIGURE I.2(h) Wind Lift Collapse — Roof Off, Walls Collapse.

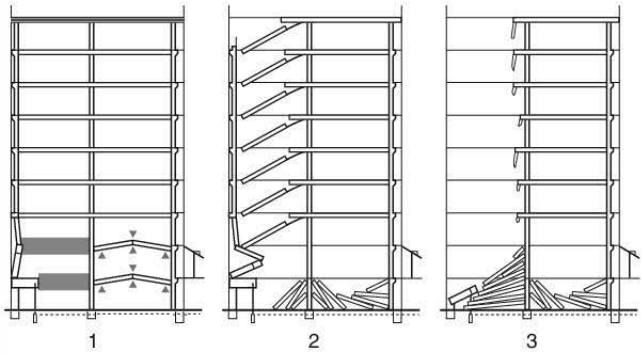

FIGURE I.2(i) Lift and Drop Collapse Pattern — Concrete Heavy Floor Construction.

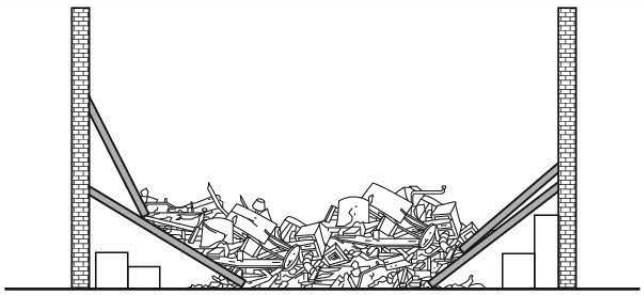

FIGURE I.2(j) Fire Burn-Out Collapse Pattern — Roof/Floor Burn-Out — Heavy Wall Construction — URM or Tilt-Up.

J.2 Awareness Level.

J.2.1 An appropriately trained veterinarian or similar individual, as identified per the AHJ, is a critical resource to improve the animal's welfare and potential outcome, as well as the safety of the first responders involved in the rescue. Local AHJ resources should be preplanned to understand roles and resources. Some of the AHJs have law enforcement officers trained and authorized to administer a limited dose of drugs, some have animal control agencies, while others have prearranged relationships with local veterinarians to assist in an emergency.

J.2.2 By using portable fencing, scene control can be established until more resources (an appropriately trained veterinarian, animal control officer, law enforcement officer, etc.) are available to provide appropriate capture, which can even require remote chemical capture delivery system assistance. *(See Figure J.2.2.)*

J.2.3 Special hazards, including being bitten, scratched, kicked, and so on can require bite gloves, bite sleeves, face shields, helmets, physical board/barriers, poles, nets, muzzles, and so forth. In the event a responder is bitten or scratched, medical treatment is required. Claws and teeth carry significant concerns for infection.

J.2.4 Awareness-level personnel should know that large animal rescue gear should not be used for human rescue and should be kept separate.

J.3 Operations Level.

J.3.1 See Figure J.3.1(a) through Figure J.3.1(f) for behavioral clues such as postures, faces, and ears of various animals.

J.3.2 See Figure J.3.2 for creating an improvised restraint device.

J.3.3 Improvised or commercial harnesses used for securing and moving animals should utilize webbing-like material (to include fire hose), 20 ft (6.096 m) or greater in length by 4 in. (10.160 cm) or greater in contact width (note 2.5 in. diameter fire hose is 4 in. contact width). This material can be used to create a simple forward assist, a slip knot/choke, or a lark's foot (also known as a girth hitch configuration) for an assist and a swiss seat on the chest (also known as a Wideman configuration) for a forward assist. Two pieces of webbing-type material, 20 ft (6.096 m) or greater in length and 4 in. (10.160 cm) or greater in width, can be used to conduct a sideways drag or sideways Hampshire Slip. A Nicopoulos needle, flossing method with webbing, or a Strop Guide or similar devices should be used to arrange webbing on the downed victim. These are commonly used methods but are not meant to be exclusive. Head and eye protection should be used during a drag/slide. For animal and responder safety, sedation should be considered before initiating a drag/slide. *[See Figure J.3.3(a) through Figure J.3.3(e).]*

J.3.4 Commercial system examples include the Becker Sling kit, UC Davis Animal Lift, and the UC Davis Anderson Sling. *(See Figure J.3.4.)* Please note the following:

(1) An improvised system can be made from webbing/fire hose [2.5 in. (6.35 cm) hose] providing at least 4 in. (10.16 cm) in contact width. At least two belly straps and one breast strap should be used on horses. There should be a spreader bar as the overhead to improve balance of the load and lessen stress on the spine of the animal. The breast strap should not be against the animal's airway. These are simple lifting systems for emergency rescue and should not be used for more than 15 minutes.

(2) Lift off and landing are the two most dangerous times. Sedation of the animal should be seriously considered when attempting a vertical lift.

(3) Using any webbing system with a girth band could increase the potential for the animal to have an adverse, sudden, and dangerous reaction such as bucking, tipping, kicking, or attempting to run. These risks can be mitigated with sedation.

FIGURE J.2.2 A Portable Fencing System Used to Contain a Loose Animal — in This Case a Llama. Many animals cannot and should not be individually restrained. ***(Photo courtesy of Henrico Fire.)***

FIGURE J.3.1(a) A Dog Inside the Alertness Zone Around the Llama. The llama's ears and eyes are watching the dog's approach — very focused to the front. When the dog gets too close the llama will attack or flee. ***(Photo courtesy of Dr. Tomas Gimenez, SC – TLAER, Inc.)***

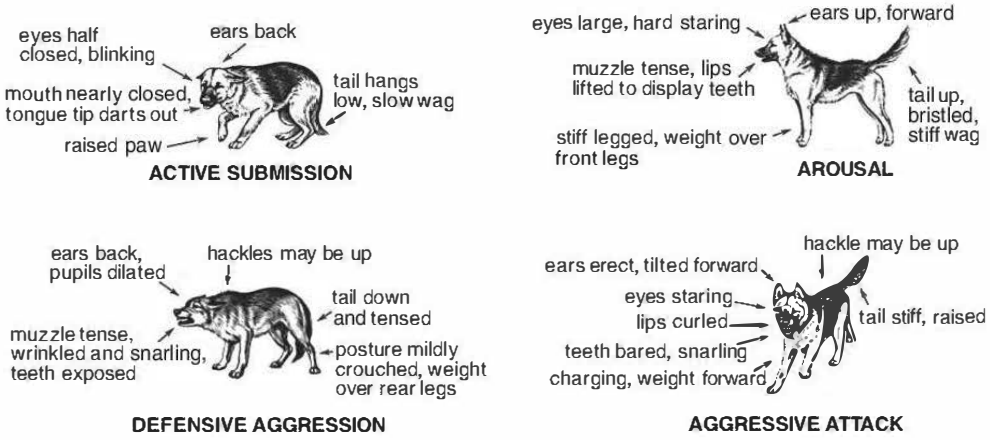

FIGURE J.3.1(b) Dog Behavior Clues. *(Images courtesy of Rescue 3 International.)*

(4) More highly engineered systems such as the Anderson Sling can be used for extended lifts and helicopter rescues as a Technician Level Skill.

J.3.5 See Figure J.3.5 for an improvised dog harness.

J.3.6 Cats should be "scruffed" behind their neck, supported under their hind end, and put in a cage, an empty rope bag, or other confined transport device, rear end first. Animals weighing under 300 lb (136.078 kg) can be considered within a "2-person load" and attached to the rescuer's primary rescue line similar to a victim pickoff with Prusiks. Dogs should be muzzled prior to trying to put in a rescue sling. See Figure J.3.6(a) through Figure J.3.6(c) for an improvised rescue muzzle.

J.3.7 Use of a mud lance/jetting wand (either air or water injected) can break the suction around the animal's legs prior to attempting an extraction from an adhesive material. *(See Figure J.3.7.)*

J.3.8 An inflatable platform can be used to access an animal out in water, mud, or surface ice. The rescuer should stay above the rescue environment. Additionally, a platform can be used as edge protection to extricate the animal with a sideways drag manipulation method. Platforms can be anything that increases the surface area of the rescuer's feet on top of the rescue environment or provides edge protection (tarps, inflated rescue platforms, plywood, Rescue Glide, etc.).

J.3.9 See Figure J.3.9 for fight or flight zones, tipping points, and so forth.

J.4 Technician Level.

J.4.1 A commercially tested and rated specialized large animal lifting system, along with specialized protocols, should be used for extended lifts to include long line helicopter operations. An example of this is the Anderson Sling.

J.4.2 Organizations should recognize the difficulty associated with attempting to sufficiently disperse the victim's body weight to move them from the water and onto the surface of the ice. Cutting a path through the ice and then treating it as a water rescue is recommended as a method of overcoming this difficulty.

J.4.3 Significant concerns in performing animal rescue are recognizing the loads involved and being able to calculate

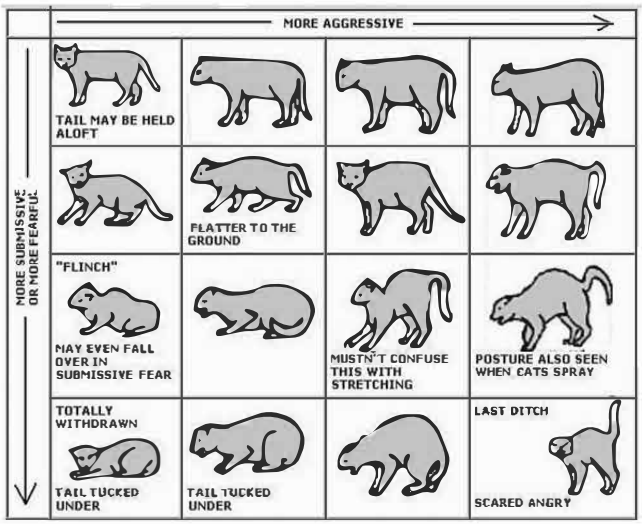

FIGURE J.3.1(c) Cat Behavior Clues. *(Image courtesy of Sarah Hartwell — www.Messybeast.com.)*

system safety factor, particularly when considering the lower system safety factor involved and how animal fight or flight behavior can create shock in the system. While small horses, bears, and certainly smaller household pets and small farm animals operate within a "2 person" rescue load, or 600 lb (272.155 kg), being able to estimate the weight of a horse, cow, or other large animal is critical given the already limited system safety factor. Based on research conducted by Rebecca Gimenez, PhD, there are several options that meet the practical use of a field rescue.Johnson, et al., 1989 evaluated trends in horsemen visually evaluating weights of horses. There was no relationship between years of experience and accuracy of estimation. Eighty-eight percent of evaluations underestimated horse weights by 186 lb (84.368 kg). Visual estimation produced errors of 20 percent to 25 percent, or 92 lb (41.731 kg). Using this method, a 1000 lb (453.592 kg) horse could weigh 750 lb (340.194 kg) or 1250 lb (566.991 kg). *(See Figure J.4.3.)*

FIGURE J.3.1(d) Aggressive Attack by a Llama on a Dog Inside the Llama's Personal Space — Specifically, Inside the Action Zone. The dog is reacting by attempting to flee. Note the llama's pinned back ears. It looks the same in horses and cattle. ***(Photo courtesy of Dr. Tomas Gimenez, SC– TLAER, Inc.)***

FIGURE J.3.1(e) The Horse on the Left Is Very Aggressive, Pinning Its Ears and Stepping Forward, While the Horse on the Right Is Stepping and Looking Backward for a Way Out. ***(Photo courtesy of Tori Miller.)***

J.4.4 Trailer accidents and the need for animal extrication face significant and complex hazards: the potential need to stabilize a trailer prior to extrication, recognizing significant weight shift as the victim is extracted, and recognition of all the potential hazards associated with a trailer (such as fuel, propane, generators, batteries, and other flammables), as well as the potential of having a person in the trailer. There is also the potential for multiple victims, interior shifted loads, animals tied in that need to be cut loose prior to extrication, and slippery fluids that might endanger the rescuers. Trailers meet the OSHA definition of "confined space" rescue.

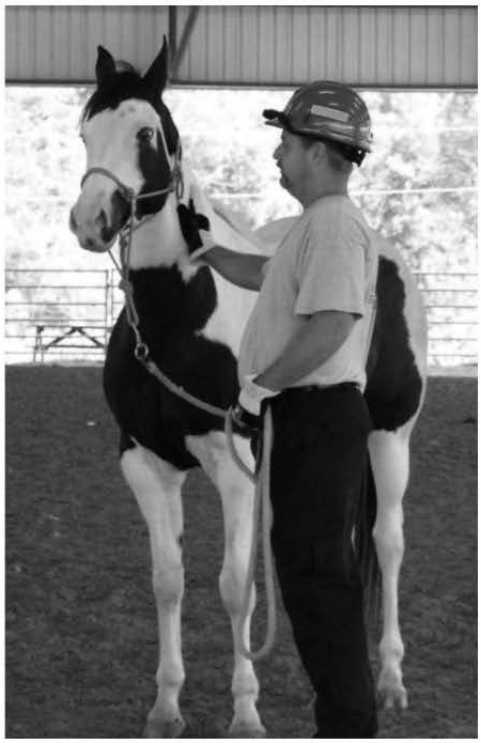

FIGURE J.3.1(f) A Horse Using Its Ears and Eyes to "Watch" Behind Itself. The horse is aware of something behind it. If the horse gets concerned enough it will attempt to turn around and alert on the object or animal by putting its eyes and ears on it. Also note, the responder is in a safe position near the horse's shoulder — out of the "fight or flight" path. ***(Photo courtesy of Rebecca Gimenez, PhD, GA – TLAER, Inc.)***

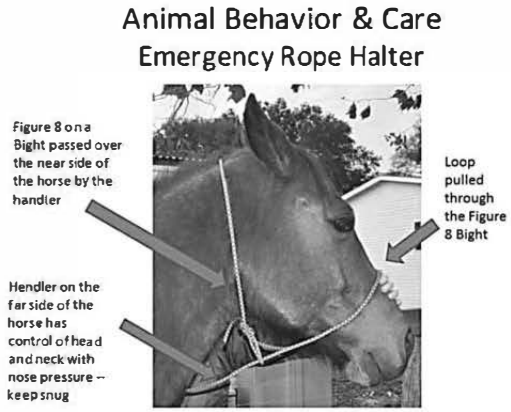
Animal Behavior & Care
Emergency Rope Halter
Figure 8 on a Bight passed over the near side of the horse by the handler
Loop pulled through the Figure 8 Bight
Hendler on the far side of the horse has control of head and neck with nose pressure -- keep snug

FIGURE J.3.2 Emergency Rope Halter. Start with 15 ft to 20 ft of rope, put the bight over the horse's neck, and collect it back to the starting side. Using the standing portion of rope, push a small loop through the bight, feed that loop over the animal's nose, and dress the rope over the nose and behind the ears of the horse. Use the standing portion of the rope as the leadrope. ***(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

Securing and Moving Animals
Forward Assists
Simple Forward Assist
Pros:
• Quick and easy to put on and remove
• Only requires 20 Ft of wide webbing
Cons:
• As soon as tension on the system is released, the webbing becomes a trip/leg burn risk to the animal
Center middle of webbing at top of animal's back, pull ends between front legs

FIGURE J.3.3(a) Simple Forward Assist. Large animals need egress room to move forward and the path should be twice as wide and 1 ½ times as tall as the animal for the safety of the animal and the handler. Horses should be able to move their heads to balance and assist in rescues. ***(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

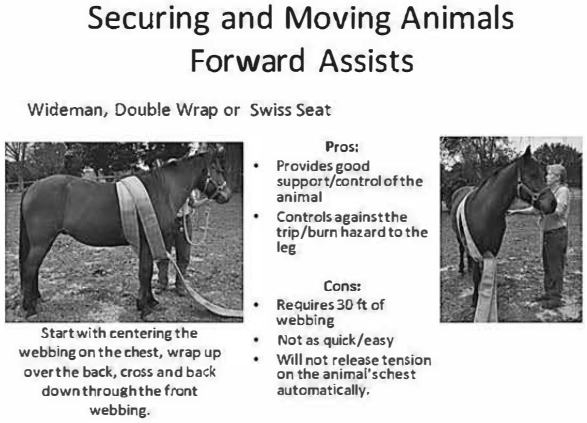
Securing and Moving Animals
Forward Assists
Wideman, Double Wrap or Swiss Seat
Pros:
• Provides good support/control of the animal
• Controls against the trip/burn hazard to the leg
Cons:
• Requires 30 ft of webbing
• Not as quick/easy
• Will not release tension on the animal's chest automatically.
Start with centering the webbing on the chest, wrap up over the back, cross and back down through the front webbing.

FIGURE J.3.3(b) Wideman, Double Wrap, or Swiss Seat. ***(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

J.4.4.1 In *extremely* rare instances, the trailer might have only turned over partway, and it might have sufficient structural integrity to allow for an uprighting before extrication of the animal victims.

J.4.4.2 Normally the animal will have already righted itself inside the trailer, and it would be more stressful and dangerous to attempt to upright the trailer. *(See Figure J.4.4.2.)*

J.4.4.3 Numerous obstacles inside most trailers (chains, gates, dividers, and hay nets) can further entrap the animal. As with human incidents, responders should follow normal vehicle extrication techniques, such as flapping the metal outward and padding to allow for dragging the victim out. Soap or other friction reduction agents might also be helpful.

Securing and Moving Animals
Forward Assists
Lark's Foot (Cinch)
Pro:
• Only requires 20 Ft of webbing
• Extremely secure
• Can be used above shoulders as well
Con:
• Can create significant pressure on the animal's chest.
Slip the webbing through the eye of the webbing end and pull

FIGURE J.3.3(c) Lark's Foot (also known as the Girth Hitch). ***(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

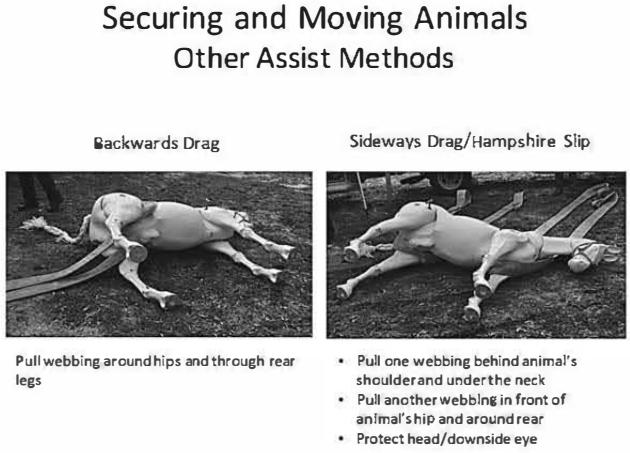
Securing and Moving Animals
Other Assist Methods
Backwards Drag
Sideways Drag/Hampshire Slip
Pull webbing around hips and through rear legs
• Pull one webbing behind animal's shoulder and under the neck
• Pull another webbing in front of animal's hip and around rear
• Protect head/downside eye

FIGURE J.3.3(d) Backwards Drag and Sideways Drag/ Hampshire Slip. ***(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

J.4.5 Airlift special concerns such as Anderson sling needs, drogue chutes, and so on should be considered with the use of a Type II helicopter. It should be noted that improvised webbing, slings, and so forth should not be used for extended lifts. They do not provide proper support of the animal and will result in excess chest pressure, making it difficult for the animal to breathe. The added risk of panic with the wind, noise, and so on from a helicopter can increase the risk of the animal coming out of a less encompassing system.

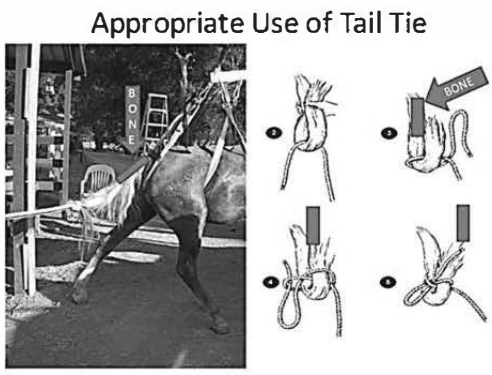

FIGURE J.3.3(e) Use of a Tail Tie for Direction Pulls, Rear End Manipulation, and Assisting with Standing Efforts. It is acceptable practice to use the tail tie as a point of attachment in maneuvering a horse with the following considerations: the knot is tied below the tailbone to prevent life-threatening injury to the horse, and only nonmotorized, nonmechanical advantage, single-person force should be used when utilizing the tail for pulling or lifting. A sheet bend with a quick release is commonly used for this application. ***(Image courtesy of Dr. John Madigan, UC Davis College of Veterinary Medicine.)***

FIGURE J.3.4 The Becker Sling System. Here it is used in a vertical lift of a live animal [weighing 1325 lb (601 kg)] with a TLAER-rated A frame. The overhead features two lifting points and an emergency release system. The breast strap does not impede the trachea — it just holds the strap behind the front legs in position. The lead line attached to the horse's head is used for control during and after the rescue. ***(Photo courtesy of Henrico Fire, VA.)***

J.4.6 Animals often find themselves in sewer-like environments, such as canals with chemicals after flooding, which might require the responder to treat the rescue as a hazmat-type event. This will entail proper PPE for the rescuers both during the rescue and during any decontamination of the victim. Handling skills are considered paramount, use of sedation is usually necessary, and the logistical considerations could make rescue challenging in most scenarios involving multiple animals.

FIGURE J.3.5 Rescue 3 International Technique. This is essentially a "swiss seat" configuration, which takes the pressure off of the animal's airway when lifted, and, by grabbing all the loops around the body, ensures no cinching during the lift. ***(Photo courtesy of John Haven, University of Florida – College of Veterinary Medicine.)***

FIGURE J.3.6(a) Improvised Rescue Muzzle — Step One. A simple overhand knot in a webbing-like material can then be slipped over an animal's muzzle. ***(Photo courtesy of Sierra Rescue.)***

FIGURE J.3.6(b) Improvised Rescue Muzzle — Step Two. The muzzle can then be secured with an additional overhand knot under the jaw. *(Photo courtesy of Sierra Rescue.)*

FIGURE J.3.6(c) Improvised Rescue Muzzle — Step Three. The muzzle can be secured behind the animal's head with a quick-release knot. *(Photo courtesy of Sierra Rescue.)*

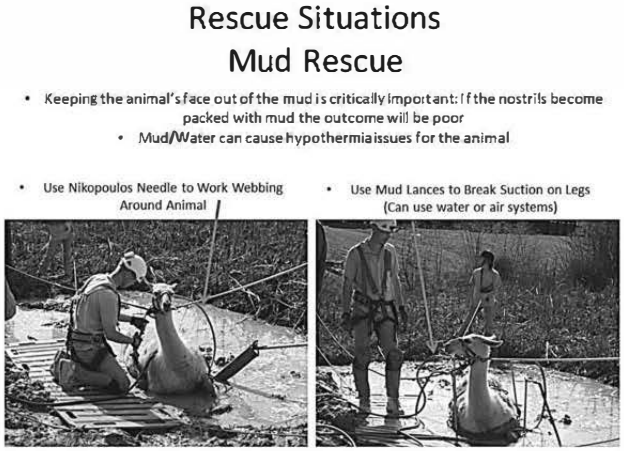
Rescue Situations
Mud Rescue
• Keeping the animal's face out of the mud is critically important: If the nostrils become packed with mud the outcome will be poor
• Mud/Water can cause hypothermia issues for the animal
• Use Nikopoulos Needle to Work Webbing Around Animal
• Use Mud Lances to Break Suction on Legs (Can use water or air systems)

FIGURE J.3.7 Mud Rescue. *(Image courtesy of John Haven, University of Florida – College of Veterinary Medicine.)*

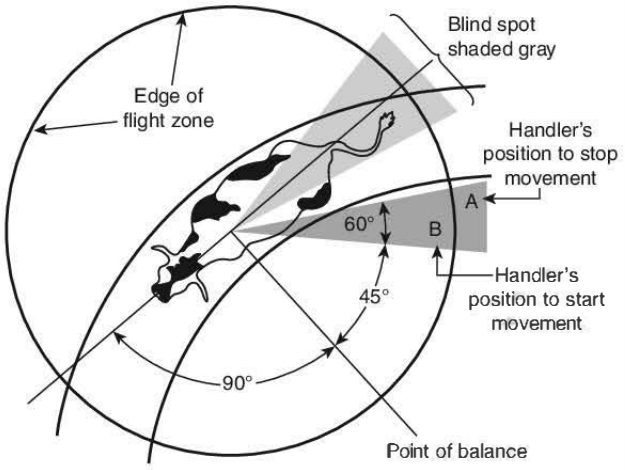

FIGURE J.3.9 Diagram of a Cow's Flight Zone and Point of Balance. Body position in relation to the animal's shoulder, or point of balance, can be used to turn the animal in a different direction. If a responder moves into the flight zone behind the point of balance, the animal will move forward. If a responder moves into the flight zone in front of the point of balance, the animal will turn and head in the opposite direction. The angle of approach determines the angle at which the animal will move away from a rescuer. Movement will stop when the responder moves out of the animal's flight zone. *(Image courtesy of Temple Grandin, PhD, 1989.)*

FIGURE J.4.3 A Veterinarian Uses a Weight Tape to Measure the Weight of a Neglected Horse. Weight tape has an effective margin of error of 15 percent. The "cowboy method" (heart girth × heart girth × length / 300 + 50 = weight) has a margin of error of up to 15 percent. *(Photo courtesy of PEARL, Inc.)*

FIGURE J.4.4.2 A Horse Trying to Right Itself. Rescuers should be aware that floormats or the flooring itself might have come loose or shifted. ***(Photo courtesy of Rebecca Gimenez, PhD – TLAER, Inc.)***

Annex K Informational References

K.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

K.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 220, *Standard on Types of Building Construction*, 2015 edition.

NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2013 edition.

NFPA 473, *Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2013 edition.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2017 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2013 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, 2014 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program*, 2015 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, 2013 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2017 edition.

K.1.2 Other Publications.

K.1.2.1 BOCA Publications. Building Officials and Code Administrators International, 4051 W. Flossmoor Road, Country Club Hills, IL 60478-5795.

National Building Code, 1999.

K.1.2.2 CENELEC Publications. CENELEC, European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Avenue Marnix 17, 4th floor, B-1050 1000 Brussels.

EN 393 (ISO 12402-5), *Personal flotation devices — Part 5: Buoyancy aids (level 50) — Safety requirements*, 2006.

EN 395 (ISO 12402-4), *Personal flotation devices — Part 4: Lifejackets, performance level 100 — Safety requirements*, 2006.

EN 396 (ISO 12402-3), *Personal flotation devices — Part 3: Lifejackets, performance level 150 — Safety requirements*, 2006.

EN 399 (ISO 12402-2), *Personal flotation devices — Part 2: Lifejackets, performance level 275 — Safety requirements*, 2010.

K.1.2.3 ICBO Publications. International Conference of Building Officials, 5360 S. Workman Mill Road, Whittier, CA 90601-2298.

Uniform Building Code, 1997.

K.1.2.4 SBC Publications. Southern Building Code Congress International, 900 Montclair Road, Birmingham, AL 35213.

Standard Building Code, 1999.

K.1.2.5 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, 20401-0001.

FAA, *Aeronautical Information Manual*, April 3, 2014.

FEMA Disaster Assistance Policy DAP9523.19, 2007.

FEMA National Urban Search and Rescue (US&R) Response System, 2013. Available online at http://www.fema.gov/urban-search-rescue.

DHS/FEMA Disaster Assistance Policy DAP9523.19, 2007.

DHS/FEMA National Urban Search and Rescue (US & R) Response System, 2013. Available online at http://www.fema.gov/urban-search-rescue.

FEMA Earthquake Hazards Reduction Series 41, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook*, 2002.

FEMA National Response Framework, 2nd edition, May 2013.

H.R. 3858 (109th): Pets Evacuation and Transportation Standards Act of 2006.

National Search and Rescue Committee, *U.S. National Search and Rescue*, Plan, 2007.

National Search and Rescue Committee, *U.S. National Search and Rescue, Supplement to the International Aeronautical and Maritime Search and Rescue Manual*, 2000.

Title 29, Code of Federal Regulations, Part 1910.120, "U.S. Federal OSHA Standard on Hazardous Waste Operations and Emergency Response (HAZWOPER)."

Title 29, Code of Federal Regulations, Part 1910.146, "Permit-Required Confined Spaces."

Title 29, Code of Federal Regulations, Part 1910.1030, "Blood-Borne Pathogens."

Title 29, Code of Federal Regulations, Part 1926, Subpart P, Appendix A, "Soil Classification."

Title 29, Code of Federal Regulations, Part 1926, Subpart P, Appendix B, "Excavations, Sloping and Benching."

Title 29, Code of Federal Regulations, Part 1926, Subpart P, Appendix C, "Timber Shorting for Trenches."

Title 29, Code of Federal Regulations, Part 1926.651, "Specific Excavation Requirements."

Title 29, Code of Federal Regulations, Part 1926.652, Subpart P, "Requirements for Protective Systems."

Title 29, Code of Federal Regulations, Part 1926.800, "Underground Construction."

Title 30, Code of Federal Regulations, Part 49.2, "Availability of Mine Rescue Teams."

U.S. Army Corps Engineers, Urban Search and Rescue Program, Field Operations Guide, 6th edition, 2009.

K.1.2.6 Other Publications. IMO/ICAO, *International Aeronautical and Maritime Search and Rescue Manual: Vol. I–III,* International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO), London/Montreal, 2013.

Mountain Rescue Association, *Mountain Rescue Association Policies, POLICY 105 Personnel Guidelines,* 1999.

K.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

The following list provides additional sources for information on the operations and training of technical rescue incidents.

K.2.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA *101®, Life Safety Code®,* 2015 edition.

NFPA 1600®, Standard on Disaster/Emergency Management and Business Continuity/Continuity of Operations Programs, 2016 edition.

NFPA 1620, *Standard for Pre-Incident Planning,* 2015 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection,* 2013 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

K.2.2 ICC Publications. International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001. (www.iccsafe.org)

International Building Code

International Existing Building Code

International Fire Code

International Fuel Gas Code

International Mechanical Code

International Plumbing Code

International Residential Code

K.2.3 U.S. Government Publications. U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Federal Emergency Management Agency, U.S. Fire Administration, *New Techniques in Vehicle Extrication,* FA-152, FEMA USFA, Emmitsburg, MD, September, 1994.

National Search and Rescue Committee, *Catastrophic Incident Search and Rescue Addendum to the National Search and Rescue Supplement to the International Aeronautical and Maritime Search and Rescue Manual,* Version 2.0, 2009.

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